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REPORT ON THE ENVIRONMENTAL IMPACT ASSESSMENT OF THE BALTIC POWER OFFSHORE WIND FARM

Applicant	**Baltic Power Sp. z o.o.**
Contractor	**MEWO S.A.**
	Maritime Institute **Gdynia Maritime University**
Subcontractors	**National Marine Fisheries Research Institute**
	DHI Polska Sp. z o.o.
	IfAÖ
	MAREA Sp. z o.o.

Declaration

I declare that I meet the requirements referred to in Article 74a.2 of the Act of 3 October 2008 on the provision of information on the environment and its protection, public participation in environmental protection and environmental impact assessments (Journal of Laws of 2008, No. 199, item 1227, as amended) and I am aware of criminal liability for making a false declaration.

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Abbreviations and definitions

µPa	micropascal – a unit of pressure
AIS	Automatic Identification System; all ships with gross tonnage of over 300 t are equipped with AIS. It provides automatic exchange of data, which helps to avoid collisions between ships and to identify ships for the coastal marine vessel traffic service
Applicant/Investor	Baltic Power Sp. z o.o.
APV	Applicant Proposed Variant
Baltic Power OWF Area	the area of the Baltic Power Offshore Wind Farm in accordance with the permit of 9 May 2012 for the construction and use of artificial islands, structures and devices issued by the Minister of Transport, Construction and the Maritime Economy (document no. GT7/62/1165483/decyzja/2012)
Baltic Power OWF DA	Baltic Power OWF Development Area
Baltica 2	Baltica 2 Offshore Wind Farm
Baltica 3	Baltica 3 Offshore Wind Farm
Bałtyk II	Offshore Wind Farm Polenergia Bałtyk II (previously Bałtyk Środkowy II)
Bałtyk III	Offshore Wind Farm Polenergia Bałtyk III (previously Bałtyk Środkowy III)
BBC	Big Bubble Curtain – underwater noise reduction system
BHD	Backhoe Dreger – type of a dredger
BIAS	Baltic International Acoustic Survey
BirdLife International	international non-governmental organisation working to protect birds and their habitats
Birds Directive	Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (OJ L 20/7 of 26.01.2010)
BOD_5	5-day biochemical oxygen demand
BSAP	Baltic Sea Action Plan for improving the environmental quality of the Baltic Sea
CFCs	chlorofluorocarbons
chiropterofauna	bats
CIEP	Chief Inspectorate of Environmental Protection
CO_2	carbon dioxide
C-POD	Continuous Porpoise Detector

CSD	Cutter Suction Dredger – type of a dredger
dB	decibel – a logarithmic measure of sound intensity (pressure)
DBT	dibutyltin
DEC	Decision on Environmental Conditions within the meaning of the Act of 3 October 2008 on the provision of information on the environment and environmental protection, public participation in environmental protection and on environmental impact assessments (Journal of Laws of 2008, No. 199, item 1227, as amended)
DHI	DHI Polska Sp. z o.o.
diving benthivorous birds	species of water birds feeding on benthic organisms for which they dive to the bottom of water bodies
DPD	detection positive day
DPM	detection positive minute
EEZ	Exclusive Economic Zone within the meaning of the Act of 21 March 1991 on the maritime areas of the Republic of Poland and maritime administration (Journal of Laws of 1991, No. 32, item 131 as amended)
EIA	Environmental Impact Assessment – procedure constituting part of the proceedings for issuing a decision on environmental conditions, which is carried out by an authority competent to issue such decision
EIA Act	Act of 3 October 2008 on the provision of information on the environment and environmental protection, public participation in environmental protection and on environmental impact assessments (Journal of Laws of 2008, item 199, as amended)
EIA Report	Environmental Impact Assessment Report within the meaning of the Act of 3 October 2008 on the provision of information on the environment and environmental protection, public participation in environmental protection and on environmental impact assessments (Journal of Laws of 2008, No. 199, item 1227, as amended)
EMF	electromagnetic field
epifauna	aggregate of invertebrate organisms inhabiting the surface layer of seabed sediment
EU	European Union
euphotic zone	surface water layer the lower limit of which is determined by the depth at which photosynthetic active radiation is degraded down to 1% of its surface strength
EUROBATS	Agreement on the Conservation of Populations of European Bats
GBS	Gravity-Based Structure

GD	Grab Dredger – type of a dredger
GDEP	General Directorate for Environmental Protection
GMDSS	Global Maritime Distress and Safety System
Habitats Directive	Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (OJ UE L 206 of 22.07.1992)
habituation	getting acclimated to the permanent occurrence of a given factor that does not pose a direct threat
heavy metals	Group of metals characterised by high density and often toxicity (arsenic, chromium, zinc, copper, cadmium, lead, mercury, nickel)
HELCOM	Helsinki Commission – Baltic Marine Environment Protection Commission
HF	high frequency
HFCs	hydrofluorocarbons
HF-weighted SEL	sound exposure level with frequency weighting function according to susceptibility to noise-induced hearing damage in porpoises (NMFS 2018 was used in the EIA Report)
HM_01	monitoring point located in the centre of the OWF Area (1 NM) at a depth of 38 m
Hz	hertz – unit of frequency, where 1 Hz is 1 cycle per second
IALA	International Association of Lighthouse Authorities
ICES	International Council for the Exploration of the Sea
ICES 25–26	ICES Subdivisions 25–26
ICES 32 Ex GoR	ICES subdivision 32 excluding Gulf of Riga
IMO	International Maritime Organization
IMWM-NRI	Institute of Meteorology and Water Management – National Research Institute
ind.	individual/individuals
infauna	aggregate of invertebrates living in seabed sediments
IUCN	International Union for Conservation of Nature
kHz	kilohertz – unit of frequency, where 1 kHz is 1000 cycles per second
LC	Least Concern – according to the IUCN Red List categories, it denotes species which do not meet the criteria for being classified as threatened or near-threatened; this group includes common, widely distributed species
LOI	organic matter content in a sample, marked as loss on ignition

LUA	Limited Use Area
macrozoobenthos	a complex of invertebrate organisms living on the surface of seabed sediments (epifauna) or inside the sediment, which remain during the sediment rinsing on a sieve with a mesh size of 1 mm
MARPOL 73/78	International Convention for the Prevention of Pollution from Ships, adopted in London on 2 November 1973, together with Annexes I, II, III, IV, and V as well as the 1978 Protocol relating thereto, together with Annex I adopted in London on 17 February 1978
MBT	monobutyltin
MI GMU	Maritime Institute Gdynia Maritime University
Monitoring of Marine Habitats and Species	monitoring of marine habitats and species conducted as part of the State Environmental Monitoring
MSFD	Marine Strategy Framework Directive (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 (OJ L 164, 164/19, as amended)
MVA	megavolt-ampere − unit of apparent power
MW	megawatt − unit of power in the International System of Units (SI)
MWS	Monitoring of Wintering Species conducted as part of the State Environmental Monitoring
NFDCP	National Fisheries Data Collection Programme
NM	nautical mile
NMFS	National Marine Fisheries Service – US federal agency responsible for the management of national marine resources, which has published criteria for assessing the impact of noise on marine mammals, including the weighting of the frequency of sounds received
NOAA	National Oceanic and Atmospheric Administration
NOVANA	program of the Danish Environmental Protection Agency, including the monitoring of Natura 2000 sites
NPS	National Power System
NRS	Noise Reduction System
NSDC	National Spatial Development Concept
NSMS	National Maritime Security System
NT	Near-Threatened species, according to the IUCN Red List categories (close to but not yet classified as VU category)

nutrients	essential chemical elements (biogenic substances) found in every living organism, including: carbon, hydrogen, nitrogen, oxygen, phosphorus and sulphur
OHS	Occupational Health and Safety
omnivores	omnivorous bird species which prefer fish when at open sea, most often they pick discards produced during pre-treatment of fish on fishing boats
OSPAR	Convention for the protection of the marine environment of the North-East Atlantic of 22 September 1992 (OJ L 1998, No. 104, p. 2)
OWF	Offshore Wind Farm
OWF Area (1 NM)	marine survey area covering the Baltic Power OWF Area including the 1352 m wide zone around it, with the total surface of 205 km^2
OWF Area (2 NM)	marine survey area covering the Baltic Power OWF Area including the 3204 m wide zone around it, with the total surface of 323 km^2
OWF's DA	Offshore Wind Farm Development Area – an area where the construction of offshore wind power stations is planned along with substations, accommodation and service platforms, measurement and survey platforms (including measurement masts) as well as the installation of electricity grid and telecommunication networks
OWPS	Offshore Wind Power Stations
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
phenological periods	changes in the phenomena of animate nature occurring in annual cycles
phytobenthos	aquatic plants including vascular plants rooted in the seabed (e.g. seagrass), as well as macroalgae, which attach themselves to hard surfaces (cobbles, wrecks, structures) or lie freely on the seabed
piscivorous birds	species of birds feeding on fish
PMA	Polish Maritime Areas within the meaning of the Act of 21 March 1991 on the maritime areas of the Republic of Poland and maritime administration (Journal of Laws of 1991, No. 32, item 131 as amended)
Pomeranian Voivodeship SDP	Pomeranian Voivodeship Spatial Development Plan
POPs	Persistent Organic Pollutants
PORP	Pomeranian Office for Regional Planning

PP-weighted SEL	sound exposure level with frequency weighting function according to susceptibility to noise-induced hearing damage in seals (NMFS 2018 was used in the EIA Report)
PSE S.A.	PSE S.A.
PSzW	permission for the construction and use of the artificial islands, installations and devices in the Polish Maritime Areas in accordance with the Act of 21 March 1991 on the maritime areas of the Republic of Poland and maritime administration (Journal of Laws of 1991, No. 32, item. 131, as amended.)
PSzW No. MFW/6/12 as amended	permit of 9 May 2012 for the construction and use of artificial islands, structures and devices, issued by the Minister of Transport, Construction and Maritime Economy to Baltic Power Sp. z o.o., as amended, by the decision of the Minister of Maritime Economy and Inland Navigation of 22 January 2020 (ref. no. DGM.WZRMPP.3.430.80.2019.JD.2)
PTS	Permanent Threshold Shift
PTS (1-h cumulative)	Permanent Threshold Shift as a result of a cumulative noise from one-hour of piling
PTS (single strike)	Permanent Threshold Shift in marine organisms as a result of a single blow of a pile driver
PUWG 1992	State Geodetic Coordinate System 1992 (abbreviation from Polish *Państwowy Układ Współrzędnych Geodezyjnych 1992*)
RAV	Rational Alternative Variant
RCS	Radar Cross Section – the effective surface reflection of radar waves
RES	Renewable Energy Sources
resuspension	suspension and redistribution of sediment particles previously deposited on the seabed, caused by e.g. wave motion, drilling, net dragging, etc.; it can be an internal source of water enrichment with nutrients (biogenic material) accumulated in the sediment
rms	root mean square
ROV	Remotely Operated Vehicle
RP	The Republic of Poland (Polish: *Rzeczpospolita Polska*)
SAMBAH	Static Acoustic Monitoring of the Baltic Sea Harbour Porpoise − an international research project
SAR	Search and Rescue Service
SDF	Standard Data Form for the Natura 2000 sites
SDPPMA	Spatial Development Plan for Polish Maritime Areas

sea ducks	ducks of the Mergini tribe
SEL	Sound Exposure Level
SEL_{cum}	Sound Exposure Level cumulative − the level of sound exposure accumulated over a period of one hour, e.g. from multiple blows of a pile driver
SM2M	an underwater sound recorder
soft-start	procedure involving a gradual increase in pile driver impact energy and, as a consequence, a gradual increase in noise level in order to allow fish, birds and marine mammals to leave and move away from the works area
SPEC	Species of European Conservation Concern – the rank of special concern, considering the category of threat and species occurrence in Europe and in the world, assigned to bird species by BirdLife International
SPEC 2	a higher concern category (species the global populations of which are concentrated in Europe and have unfavourable conservation status in Europe)
SPEC 3	a higher concern category (species the global populations of which are not concentrated in Europe but whose conservation status in Europe is unfavourable)
species sensitivity indicator	indicator of a given bird species' sensitivity to the impact of an offshore wind farm
SPL	Sound Pressure Level
STC	Sensitivity Time Control
survey campaign (campaign)	bird counts conducted within the entire survey area during one or two survey cruises
TBT	tributyltin – organotin compound
territorial sea	Maritime area with a width of 12 nautical miles (22 224 m) measured from the baseline of the sea
TOC	Total Organic Carbon
TSHD	Trailing Suction Hopper Dredger
TSP	"typical species presence" index
TSS	Traffic Separation Scheme
TSS Słupska Bank	Traffic Separation Scheme "Słupska Bank"
TTS	Temporary Threshold Shift
TTS (1-h cumulative)	Temporary Threshold Shift as a result of a cumulative noise dose during one hour of piling

TTS (single strike)	Temporary Threshold Shift as a result of a single pile driver strike
UAS	MIKE Underwater Acoustic Simulator – original DHI software for the numerical modelling of underwater noise
UMPL	Unified Model PL – a numerical atmospheric model for Poland
UNCLOS	United Nations Conventions on the Law of the Sea
UTM33	Universal Transverse Mercator
VIEP	Voivodeship Inspectorate of Environmental Protection
VMS	Vessel Monitoring System
VU	vulnerable species, according to the IUCN Red List categories (i.e. species that may become extinct relatively soon but not as soon as those from the “endangered” category)
WFD	Water Framework Directive (Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, OJ L 327, 2000.327.1, as amended)
WGS 84	World Geodetic System 1984
WoRMS	World Register of Marine Species
zoobenthos	invertebrates inhabiting the seabed sediments both on the surface and inside

1 Preface

1.1 Introduction

This document constitutes the Environmental Impact Report for the Baltic Power Offshore Wind Farm (hereinafter referred to as: Baltic Power OWF). The Applicant is the Baltic Power OWF – Baltic Power Sp. z o.o., which is a company of the ORLEN Capital Group.

The planned project is the Baltic Power OWF with a total maximum power output of 1200 MW located in the maritime areas of the Republic of Poland, covering the area of 131.08 km^2, at a distance of approx. 22.48 km from the seashore (Figure 1.1).

The planned project covers the construction, exploitation and decommissioning of the Baltic Power OWF. It will consist of up to 126 wind power stations, 600 km cable routes and 6 substations.

Figure 1.1. Location of the planned Baltic Power OWF project [Source: own study]

On 9 May 2012, Baltic Power Sp. z o.o. received the permit No. MFW/6/12 of the Minister of Transport, Construction and Maritime Economy for construction and use of artificial islands, structures and devices in the Polish Maritime Areas for the project entitled „Zespół morskich farm wiatrowych o maksymalnej łącznej mocy 1200 MW oraz infrastruktura techniczna, pomiarowo-badawcza i serwisowa związana z etapem przygotowawczym, realizacyjnym i eksploatacyjnym" [literally: "Offshore Wind Farms Complex with a maximum total power output of 1200 MW together with technical, measurement and survey and service infrastructure related to the preparation, implementation and exploitation stages"] (document no.: GT7/62/1165483/decyzja/2012), amended by the decision of 22 January 2020 (document no.: DGM.WZRMPP.3.430.80.2019.JD.2).

Table 1.1 (Table 1.1) summarises the basic parameters of the planned Baltic Power OWF in the Applicant Proposed Variant (APV).

Table 1.1. Basic parameters of the Baltic Power OWF for the Applicant Proposed Variant

Facility name or parameter definition	Unit	Value
Number of wind power stations (maximum)	pcs.	126
Power output of a single wind power station (minimum)	MW	9.5
Number of MV/HV offshore substations (maximum)	pcs.	6
Number of hubs with a possible AC/DC converter (maximum)	pcs.	2
Length of cable routes of the inner OWF systems (maximum)	km	600

The purpose of the planned project is to generate electricity using a renewable energy source − wind.

This Environmental Impact Assessment Report comprises an Appendix to the application for a decision on environmental conditions based on the Act of 3 October 2008 on providing access to information about the environment and its protection, participation of the public in the environment protection and the environmental impact assessments (Journal of Laws of 2008, No. 199, item 1227, as amended). According to Article 75 section 1 point 1c, the Regional Director for Environmental Protection is the authority competent to issue the decision on environmental conditions for the projects executed in maritime areas. Taking into account the location of the Baltic Power OWF, the competent authority is the Regional Director for Environmental Protection in Gdańsk.

The site of the planned project is not covered by the provisions of local development plans. On 15 November 2013, the Director of Maritime Office in Gdynia, the Director of Maritime Office in Słupsk and the Director of Maritime Office in Szczecin announced the instigation of the planning process, with the aim to develop a draft “Spatial Development Plan for the Polish Maritime Areas”. The planning process includes the preparation of the “Study of conditions for the plan” and the “Plan of Spatial Development of Polish Maritime Areas.” Work on the draft plan have been completed and it is currently at the stage of departmental arrangements.

The “Environmental Impact Assessment Report for the Baltic Power Offshore Wind Farm” was prepared by the Consortium of MEWO S.A. and the Maritime Institute of the Maritime University in Gdynia (formerly: Maritime Institute in Gdańsk) in cooperation with subcontractors: NMFRI, IFAO, Marea Sp. z o.o. and DHI Polska Sp. z o.o.

1.2 Project qualification

Pursuant to the Regulation of the Council of Ministers of 10 September 2019 on projects that may have a significant impact on the environment (Journal of Laws of 2019, item 1839), the planned project is classified as a project that may always have a significant impact on the environment (pursuant to § 2 section 1 point 5) B) plants using wind energy for electricity generation located in maritime areas of the Republic of Poland are qualified as such).

Classification as projects that may always have a significant impact on the environment means the obligation to obtain a decision on environmental conditions after an obligatory conduct of the procedure regarding the environmental impact assessment of the project.

Impact of the planned project on the environment includes:

- verification of the environmental impact assessment report;
- obtaining opinions and approvals required by the Act;
- ensuring the possibility of public participation in the procedure.

The environmental impact assessment procedure requires the Regional Director for Environmental Protection to ensure the possibility of public participation, which includes, among others:

- making public the information about, among others, the instigation of the procedure and proceedings for the environmental impact assessment and also about an opportunity to review the documentation and the place where the documents are available for review and about timing, methods and venue for filing comments and requests, mentioning the 30-day deadline for their submission;
- processing of comments and requests filed;
- providing in the decision justification the information on public participation and the manner and extent to which the comments and requests were taken into account in relation to public participation;
- making public the information about issuing a decision on environmental conditions and the opportunity to review its content.

Everybody is entitled to make comments and file requests in the public consultation process; it applies, among others, to the environmental impact assessment procedure. Comments and requests may be submitted in writing, verbally to be minuted, by means of electronic communication without the need to provide them with a qualified electronic signature.

1.3 Reasons for the project implementation

The planned project, the Baltic Power OWF, is the investment of Baltic Power Sp. z o.o., which is a PKN Orlen company.

Construction of an offshore wind farm (OWF) is one of the strategic objectives of the Group. It is in line with the assumptions of the updated energy policy of Poland, assuming the construction of an OWF in the Polish Exclusive Economic Zone (EEZ) with a total power output of 4.6 GW by 2030. These activities will enable the transformation of the Polish power sector towards the use of zero-emission energy sources, which is a response to the current climate challenges faced by Poland, Europe and the world.

An important premise for the project implementation is the possibility of avoiding the emission of pollutants to the atmosphere. With a conservative assumption of 40% of power utilisation and 25 years of exploitation, a 1200 MW OWF can produce 134.03 TWh/482.50 PJ of electricity, which would allow to avoid the emission of over 48 million Mg CO_2, more than 656 thousand Mg SO_2, approx. 88 thousand Mg of nitrogen oxides and more than 1.5 million Mg of dust in coal-fired power plants.

The above indicators for the project in question will be an element of Poland's compliance with international regulations at global and regional levels.

The provisions of the United Nations Framework Convention on Climate Change, signed in 1992 in Rio de Janeiro, ratified by Poland in 1994, aimed at stabilising greenhouse gas concentrations in the atmosphere at a level that does not cause dangerous changes in the climate system are binding at the global level. A regulatory mechanism of the Convention, the so-called Kyoto Protocol, was adopted in 1997, setting a timeframe for reducing greenhouse gas emissions. The Protocol entered into force in 2005, and was ratified in Poland in 2002. In 2015, a Paris Agreement was developed to limit the global temperature rise below 2°C by the end of the 21st century. The Agreement was adopted in October 2016, also in Poland.

The planned project consisting in the generation of electricity from a renewable energy source, such as wind, in maritime areas is part of the energy policy of Poland, contributing to the reduction of negative environmental impact and reduction of greenhouse gas emissions from the power sector. It is consistent with the 2030 framework for climate and energy policy (Climate and Energy Package) of EU, the main objectives of which are:

- reduction of greenhouse gas emissions by 40% relative to the emission level from 1990;
- ensuring at least 32% share of the energy generated by renewable sources (the original target of at least 27% was corrected in 2018);
- improvement of energy efficiency by at least 32.5% (the original target of at least 27% was corrected in 2018).

The planned project, through the production of energy from a renewable source and the simultaneous reduction of CO_2 emissions, covers directly two of the three objectives of the European Union in this respect.

The Baltic Power OWF also covers a part of the objective of the EU long-term strategy adopted in November 2018 "Climate neutrality by 2050" [124] i.e. achieving zero level of greenhouse gas emissions by 2050 and the idea of a European Green Deal [440].

As estimated by experts, electricity from wind farms will be the cheapest source of electricity for the European economy. The costs of energy from this source will be up to several dozen percent cheaper than from the gas power sector.

1.4 Aim and scope of the report

The Environmental Impact Assessment Report was prepared for the purpose of the environmental impact assessment of the planned project, aimed at obtaining the decision on environmental conditions.

The purpose of the report is to determine:

- characteristics and scale of the project;
- possible variants of the project;
- environmental conditions, resources and values of abiotic, natural, cultural and landscape environment;
- existing and planned use and development of sea areas;
- other conditions resulting, among others, from special regulations, e.g. concerning the prevention of failures or construction disasters;
- nature, range and significance of the expected environmental, spatial and social impacts related to the construction and exploitation of the Baltic Power OWF;
- the possibility of avoiding, preventing, limiting and possibly compensating the identified adverse effects of the project or hazards, taking into account potential emergency situations;
- the need to formulate recommendations to be applied at the stage of designing and preparation of the investment project, its implementation and exploitation, as well as decommissioning;
- the need to protect people, health and the living conditions of people against negative impacts;
- a proposal of environmental monitoring carried out at all stages of the project.

The subject of the document is the analysis of the impact of the planned Baltic Power OWF on the environment, the comparison of the planned project variants analysed in terms of environmental protection and the indication of the variant most favourable for the environment.

The scope of the report results from the requirements specified in Article 66 of the EIA Act and contains information enabling the analysis of the criteria listed in Article 62 of the EIA Act (Table 1.2).

Table 1.2. Compliance of the contents of the Report with the provisions of Article 62 section 1 and Article 66 section 1 of the EIA Act [Source: own materials based on the EIA Act]

Provision of the EIA Act	Section of the Report
Article 62 section 1	
Identification, analysis and assessment of direct and indirect environmental impact of the project	6
Identification, analysis and assessment of direct and indirect impact of the project on the population, including human health and living conditions	6.1.1.8; 6.1.2.10; 6.1.4.9
Identification, analysis and assessment of direct and indirect impact of the project on material goods	6.1.1.6; 6.1.2.8; 6.1.4.7
Identification, analysis and assessment of direct and indirect impact of the project on monuments	6.1.1.5; 6.1.2.7; 6.1.4.6
Identification, analysis and assessment of direct and indirect impact of the project on landscape, including cultural landscape	6.1.1.7; 6.1.2.9; 6.1.4.8
Identification, analysis and assessment of direct and indirect impact of the project on the interaction between the elements referred to above	6
Identification, analysis and assessment of the direct and indirect impact of the project on the availability of mineral deposits	6.1.1.1; 6.1.2.1; 6.1.4.1
Identification, analysis and assessment of the risk of major failures and natural and construction disasters	2.5.8
Identification, analysis and assessment of possibilities and methods of preventing and reducing the negative impact of the project on the environment	11
Identification, analysis and assessment of the scope of monitoring required	12
Article 66 section 1	
Description of the planned project, including:	2
Description of the entire project and conditions for the land use during implementation and exploitation or use phases, also in relation to the flood risk areas within the meaning of Article 16 point 34 of the Act of 20 July 2017 – Water Law	2.4
Main characteristics of the production processes	2.2
Types and quantities of emissions expected, including waste, resulting from the implementation and exploitation or use phases of the planned project	2.4
Information on biodiversity, the use of natural resources, including the use of soil, water and earth surface	3.2.3; 3.7.4
Information on energy demand and its consumption	2.4.6
Information on demolition works concerning projects likely to have a significant impact on the environment	2.4.5
The risk assessed on the basis of scientific knowledge regarding major breakdowns, natural or construction disasters, taking into account the substances and technologies used, including those related to climate change	2.5.8
Description of natural elements of the environment covered by the scope of the anticipated impact of the planned project on the environment, including:	3
Description of environmental elements under protection pursuant to the Act of 16 April 2004 on nature protection and ecological corridors within the meaning of this Act,	3.7.2; 3.7.3
Description of hydromorphological, physico-chemical, biological as well as chemical properties of waters,	3.3; 3.7.1
Results of environmental surveys understood as a set of field surveys carried out in order to characterise elements of the natural environment, if such surveys were carried out, along with the description of methodology applied.	Appendix No. 1
Description of the monuments protected under the regulations concerning monument protection and care for monuments, located within the impact range of the planned project and its immediate neighbourhood	3.8
Description of the landscape within which the project is to be located	3.10

Provision of the EIA Act	Section of the Report
Information on relations to other projects, in particular on the accumulation of impacts of the implemented, completed or planned projects, for which a decision on environmental conditions has been issued, located in the area where the project is planned to be implemented and in the area of the project impact or the impacts of which fall within the area of the planned project – to the extent to which their impacts may lead to the accumulation of impacts along with the planned project	1.7; 7
Description of the predicted effects on the environment in case the project is not implemented, taking into account environmental information and scientific knowledge available	5
Description of variants, taking into account the specific characteristics of the project or its impact, including:	2.3
Applicant Proposed Variant and Rational Alternative Variant,	2.3.2; 9
Rationally most environmentally beneficial variant with justification of the choice;	2.3.2; 9
Determination of the foreseen environmental impact of the variants analysed, including in case of a serious industrial accident or natural or construction disaster, on the climate, including greenhouse gas emissions and impacts important in terms of adaptation to climatic changes, and a possible transboundary environmental impact	2.5; 8
Comparing the impacts of the variants analysed on:	6.1; 6.2
people, plants, animals, fungi and natural habitats, water and air	6.1.1.8; 6.1.1.4.1; 6.1.1.2; 6.1.1.3
Earth surface, including mass earth movements and landscape	6.1.1.1
material goods,	6.1.1.6
monuments and cultural landscape, included in the scope of the existing documentation, especially in the monument record or register,	6.1.1.5
forms of nature conservation referred to in Article 6 section 1 of the Act of 16 April 2004 on nature conservation, including the purposes and subjects of protection of Natura 2000 sites, and the continuity of ecological corridors connecting them	6.1.1.4.2; 6.1.1.4.2.1; 6.1.1.4.3
elements listed in Article 68 section 2 point 2b, if they are included in the environmental impact assessment report or if they are required by the competent authority	Not applicable
Interactions between elements mentioned in items from a to f above;	6.1; 6.2
Justification of the Applicant Proposed Variant, taking into account the information referred to in Article 66 section 1 point 6 and 6a of the EIA Act	2.3.2
Description of forecasting methods applied by the Applicant and the description of the expected significant impacts of the planned project on the environment including direct, indirect, secondary, cumulated, short term, medium term and long term environmental impacts, resulting from:	1.8; 6
existence of the project,	6.1; 6.2
use of natural resources,	6.1; 6.2
emissions	6.1; 6.2
Description of actions planned with an aim to avoid, prevent, limit or environmentally compensate adverse impacts on the environment, in particular on the forms of nature protection referred to in Article 6 section 1 of the Act of 16 April 2004 on nature conservation, including the impact on the objectives and subjects of protection of Natura 2000 sites, and on the continuity of wildlife corridors connecting them, along with assessing their effectiveness during the project implementation, exploitation and decommissioning, respectively	11
In case the planned project is connected to the use of installations, comparison of the proposed technology with a technology complying with all the requirements stated in Article 143 of the Act of 27 April 2001 – Environmental Protection Law	10
Reference to environmental objectives resulting from strategic documents important for the implementation of the project	1.6

Provision of the EIA Act	Section of the Report
Justification for meeting the conditions referred to in Article 68 points 1, 3 and 4 of the Act of 20 July 2017 – Water Law, if the project affects the possibility of achieving the environmental objectives referred to in Article 56, Article 57, Article 59 and Article 61 section 1 of that Act	3.3
Indication whether it is necessary for the planned project to establish a limited use area referred to in the Act of 27 April 2001 – Environmental Protection Law, and to determine the boundaries of such area, restrictions regarding land usage, technical requirements for civil structures and methods of their use; this does not apply to projects consisting in the construction or alteration of roads and projects consisting in the construction or alteration of a railway line or an airport for public use	13
Graphical presentation of the issues	Entire document with appendices
Presentation of the issues in the cartographic form in the scale corresponding to the subject and the detailed scope of issues analysed in the report, also enabling a comprehensive presentation of the analyses conducted regarding the environmental impact of the project	Entire document with appendices
Analysis of potential social conflicts related to the planned project	14
Presentation of proposals for monitoring the impact of the planned project at the stage of its construction and exploitation or use, in particular on the forms of nature protection referred to in Article 6 section 1 of the Act of 16 April 2004 on nature conservation, including the impact on the objectives and subjects of protection of the Natura 2000 sites, and the continuity of wildlife corridors connecting them, as well as the information on other monitoring results available which may be relevant for the determination of responsibilities in this respect	12
Indication of difficulties resulting from technological deficiencies or gaps in the current knowledge which has been encountered during the elaboration of the report	15
Non-specialist abstract on the information included in the report related to each component of the report	22
Signature of the author, and if the author of the report is a team of authors – the leader of this team, including the first and last name and preparation date of the report	Before the list of Abbreviations and Definitions
Declaration of the author, and if the author of the report is a team of authors – the team leader, on meeting the requirements referred to in Article 74a section 2 of the EIA Act	Before the list of Abbreviations and Definitions
Sources of information constituting the basis for report elaboration	17

1.5 Basis for the report

The basis for the preparation of this report was:

- Applicant's Documentation:
  - Permit for construction and use of artificial islands, structures and devices in Polish Maritime Areas for the project entitled „Zespół morskich farm wiatrowych o maksymalnej łącznej mocy 1200 MW oraz infrastruktura techniczna, pomiarowo-badawcza i serwisowa związana z etapem przygotowawczym, realizacyjnym i eksploatacyjnym" [literally: "Offshore Wind Farms Complex with a maximum total power output of 1200 MW together with technical, measurement and survey as well as service infrastructure related to the preparation, implementation and exploitation stages"] (decision No. MFW/6/12 of 9 May 2012, document no.: GT7/62/1165483/decyzja/2012),
  - *Plan przeciwdziałania zagrożeniom i zanieczyszczeniom olejowym* [Plan for prevention of oil pollution and risks], MEWO S.A., Maritime University in Gdynia, Gdańsk, 2020,
  - *Ocena ryzyka nawigacyjnego* [Navigation risk assessment], MEWO S.A., Maritime University in Gdynia, Gdańsk 2020,

   - *Ekspertyza w zakresie wpływu na bezpieczeństwo badań nad rozpoznaniem i eksploatacją zasobów mineralnych dna morskiego* [literally: Expert opinion on the impact on the safety of surveys on identification and exploitation of mineral resources of the seabed], MEWO S.A., Maritime University in Gdynia, Gdańsk, 2020,
   - Documentation containing the results of environmental surveys and inventory carried out in the period from October 2018 to March 2020 for the purpose of this EIA Report (Appendix 1 to the EIA Report);
- strategic documentation, programming and planning documents at international, national, regional and local levels;
- applicable legal regulations, including:
   - Act of 3 October 2008 on providing access to information about the environment and its protection, participation of the public in the environmental protection and environmental impact assessments (Journal of Laws of 2008, No. 199, item 1227 as amended),
   - Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (amended by the Directive of 16 April 2014),
   - other international, EU and national regulations.

Moreover, when preparing this EIA Report, sources of information specified in section 17 were used, in particular, reports on environmental impact assessment or other documentation for projects completed, implemented or planned, located closest to the planned project, such as:

- Environmental Impact Assessment Report for the Bałtyk Środkowy III Offshore Wind Farm (currently the Bałtyk III OWF);
- Environmental Impact Assessment Report for the Bałtyk Środkowy II Offshore Wind Farm (currently the Bałtyk II OWF);
- Environmental Impact Assessment Report for the Baltica Offshore Wind Farm.

1.6 Findings of the strategic and planning documents

The subsection 1.3 indicates the main premises concerning the implementation of the project. These include increasing the share of renewable energy and reducing greenhouse gas emissions to the atmosphere. Other international and national documents, the provisions of which affect the planned project or the provisions of which are implemented by the planned project, are presented below.

1.6.1 International and EU documents

The Baltic region is characterised by a long-standing international cooperation in areas such as development and spatial planning (VASAB), marine environment protection (HELCOM) and energy (BASREC). The European Union Strategy for the Baltic Sea Region (EUSBSR), which is the first EU macro-regional intra-EU strategy, was adopted in 2009.

VASAB — intergovernmental cooperation between Baltic Sea Region ministers responsible for development and spatial planning. In its strategic document VASAB Long-Term Perspective for the Territorial Development of the Baltic Sea Region (2009) sets out the directions of the region development until 2030. One of them is to strengthen internal and external availability, and the development of offshore wind energy is indicated as a way to achieve the energy independence of the region. Measure 18 of the LTP directly indicates the need to exploit potential in Polish Maritime Areas

(PMA) in the short term. The planned project is part of the development directions for the Baltic Sea region suggested by VASAB.

Poland is a signatory to the **1992 Convention for the Protection of the Marine Environment of the Baltic Sea Area** (Helsinki Convention). Under the Helsinki Convention, actions for the Conservation of the Baltic Sea focus on the implementation of the Baltic Action Plan (BAP), adopted at the HELCOM Ministerial Meeting in 2007. The Baltic Action Plan assumes that good ecological status of the Baltic Sea will be achieved by 2021 and sets out the areas of action to achieve this. The paramount strategic objective of segment IV "Maritime activities" is that maritime transport and economic activities are carried out in the Baltic Sea in an environmentally friendly manner. One of the priorities is the minimum risks posed by offshore structures. Countries have agreed within the framework of the BAP that they will follow relevant procedures and make efforts to eliminate, reduce or compensate potential negative environmental impacts which may be caused by offshore structures. The 2013 Ministerial Conference in Copenhagen adopted the **Recommendation 34E/1** for the protection of important bird habitats and migration routes in the Baltic Sea against the negative effects of wind and wave energy production at sea. This document emphasises a positive aspect of the development of wind energy in the context of climate change, recommending specific steps that may help to reduce the negative impact of the project on the environment. It should be emphasised that the planned project will be implemented in accordance with the Recommendation 34E/1 of HELCOM. The provisions of this recommendation refer mainly to the activities of the States Parties to the Helsinki Convention and as such do not concern the planned project, but the Applicant assumes that the project will be conducted so as to avoid or minimise the impact of the project on the environment, including, in particular, on important bird habitats and their migration routes.

1.6.2 Documents at the national and regional level

The planned investment project pursues directly the objectives described in the national and regional documents quoted below. These objectives are mainly aimed at avoiding harmful gas emissions in various ways, increasing the share of energy from renewable energy sources (RES) in energy production and increasing the level of energy security.

National documents

The National Spatial Development Concept 2030 was adopted by Resolution No. 239 of the Council of Ministers of 13 December 2011. (M.P.2012.252). It is the main document on spatial development in the long term, defining the objectives and directions of the spatial development policy of the country. It takes into account the need to develop OWFs in order to solve the problem of underinvestment in the energy infrastructure and improve the energy security of the country. The development of offshore wind energy will contribute to the reduction of CO_2 emission in accordance with the arrangements of the European Union. The concept specifies that the wind energy will constitute 45% of the energy obtained from RES. The need to build new transmission lines with accompanying infrastructure, the need to take into account air corridors of bird migration and landscape protection as well as weather variability were considered as barriers to RES development in Poland. In accordance with the arrangements of the National Spatial Development Concept (NSDC) 2030, the planned project is located in the development zone of the distributed renewable wind energy sector. The NSDC 2030 sets 6 objectives pursuing the strategic objective. The planned project is part of objective 5: "*Increasing the spatial structure resilience to natural hazards and loss of energy security, as well as shaping the spatial structures supporting the state defense capabilities.*" One of the directions behind this objective is "*increasing the use of renewable energy sources through the construction of new capacities that will* *reduce losses related to energy transmission and increase energy security at the national, regional and local levels."* "*One of the elements of support for diversification of energy sources, which also has positive effects on reducing* CO_2 *emissions, is to increase the generation of energy from renewable sources. In Polish conditions, this type of sources with the highest economic potential includes wind energy (...)*." "*By 2020, at least 15% of final gross energy consumption is planned to come from renewable energy sources*."

The **Maritime Policy of the Republic of Poland until 2020** (with an outlook until 2030), adopted by the Council of Ministers on 17 March 2015, specifies that the real potential of development of offshore wind energy in Poland, which may bring the greatest benefits for the Polish energy balance and the Polish economy, amounts to 6 GW of power installed in the OWF until 2030, of which 1 GW in 2020 and another 2 GW until 2025. Creating conditions for the construction of offshore wind farms has been identified as an action to improve energy security.

The Energy Policy of Poland until 2030, adopted by the Council of Ministers on 10 November 2009, is a valid government document specifying the directions of development of the power system, including the indication of sources of electricity supply. In the "Forecast of Fuel and Energy Demand until 2030", which constitutes Appendix No. 2 to the "The Energy Policy of Poland until 2030", the economic potential of wind energy resources in PMA was estimated at 19 TWh per year.

In the **Draft Polish Energy Policy until 2040** (presented in November 2019) (version 2.1), offshore wind energy was indicated as one of the ways of increasing the RES share in the power sector, however without indicating detailed quantitative objectives. It is assumed that the law will be prepared in 2020 in order to enable the start-up of the first OWF in Poland in 2025 and further development of this technology in Polish conditions as a project of strategic energy policy.

The Strategy for Responsible Development until 2020 (with an outlook until 2030) also responds to the provisions of EUROPE 2020 Strategy. It specifies that the modernisation of generation sources and innovative solutions in the economic sector, along with the development of available capacities from renewable sources, will contribute to the reduction of greenhouse gas emissions. The Strategy states that RES sources are mostly non-controllable sources. Continuous subsidisation of RES causes serious disturbances in the functioning of energy markets – causing an increase in energy prices. Therefore, the Strategy identified as necessary, among others:

- ensuring the possibility of balancing and interaction of RES sources with other sources (not subject to limitations by forces of nature);
- evolutionary process of changes.

The development of offshore wind energy was also taken into account in **the Transmission Network Development Plan for the 2018−2027**, prepared by Polskie Sieci Elektroenergetyczne S.A. (PSE). The part concerning potential directions of transmission networks extension ensuring the reliability of the power system indicates the performance of analytical works in the scope of offshore transmission networks construction and indicates that among the expected system effects of the development of the extra high voltage networks is the preparation of the capability for connection and output of the installed power on wind farms at the level allowing to meet the RES share in the energy balance of the country. The document also presents various OWF connection scenarios.

The National Program for Low-Emission Economic Development determines the need for greater diversification of the energy mix. Mainly coastal areas were identified as the location of wind farms. It was also specified that modernisation and extension of the national power system is required to meet the requirements of the RES market. It was stated in the document that the maximum productivity of the OWF in the PMA is estimated at 12 GW of installed capacity and 48–56 TWh of energy per year. The real investment plans until 2030 amount to 6 GW. The document specifies that for the development of offshore wind energy in Poland, it is necessary, among others:

- to conduct analyses in the scope of the grounds for the OWF development in Poland;
- to develop offshore power networks.

Spatial Development Plan for the Polish Maritime Areas (SDPPMA) is under preparation. The document, the adoption of which is expected in 2021, is to take into account PSzW decisions and other decisions issued until the commencement of work on SDPPMA (e.g. permits for laying cables or pipelines), in accordance with the assumptions presented by the maritime administration during the public consultation for the preparation of this document. Therefore, it should be stated that the planned project will be in line with the arrangements of the SDPPMA.

The National Energy and Climate Plan 2021−2030 indicates in its assumptions and targets, among others, the expected increase in the share of renewable energy sources in the final gross energy consumption to approx. 32% in the power sector. This document also recognises, taking into account the existing RES development in Poland, that this is an ambitious obligation.

Regional documents

The Pomeranian Voivodeship Development Strategy 2020 adopted by the Pomeranian Regional Assembly by the Resolution No. 458/XXII/12 of 24 September 2012 is the basic strategic document setting out the directions of the Pomeranian Voivodeship development. The Strategy sets three key objectives: State-of-the-art Economy, Active Residents and Attractive Space. They are defined in 10 operational measures and 35 directions of action. The planned project contributes to the achievement of operational objective 3.2. "Energy security and efficiency" by using the potential of marine areas for the development of renewable energy. The Pomeranian Voivodeship was presented as strongly dependent on external electricity supplies. The development of this sector can create many jobs. The Regional Strategic Programme for energy and environment **Eco-efficient Pomerania** (2013) identifies the development of low-emission energy sources as one of the priorities.

The Pomeranian Voivodeship Spatial Development Plan 2030 was adopted by Resolution No. 318/XXX/16 of the Pomeranian Regional Assembly of 29 December 2016. In the area of spatial policy, it focuses, among others, on the increase in electricity production and the transformation of the region into a national leader in renewable energy production. The spatial policy activities and projects included in the Pomeranian Voivodeship Spatial Development Plan 2030 (PVSDP) include, among others: "…construction of transmission networks, distribution networks and substations for power output from new systems and renewable energy sources (wind farms, including offshore…) (…) extension of the 400/110 kV Żarnowiec substation for the possibility of connection of offshore wind farms to the National Power System (NPS)…" The Pomeranian Voivodeship Spatial Development Plan 2030 (PBPR) outlines the vision of spatial transformations of the region. One of the elements of the vision is the thesis that as a result of installation of large power capacities within the voivodeship, in the form of a nuclear power plant, coal-fired power plant and OWE, as well as due to the development of distributed power sector, the security of energy supply of Northern Poland will be improved and the voivodeship will become energetically self-sufficient. It is indicated that in the ports in Łeba, Ustka and Władysławowo, the shipyard areas should be activated for the activities related to the management of maritime areas (e.g. logistic and service and maintenance centre for the OWF).

1.6.3 Summary of the findings of the strategic and planning documents

The planned project remains in line with the expectations of many policies and strategies, in particular, the ones concerning environmental protection (reduction of pollution emissions), sustainable development (use of renewable energy sources) and energy security (independence from external energy sources). **The planned project is included in the environmental objectives of the applicable strategic and planning documents analysed.**

1.7 Information on the links between the Baltic Power OWF and other projects

In the Baltic Power OWF Area, it is planned to launch other OWFs. Currently, seven permits for the construction and use of artificial islands, structures and devices in maritime areas in the vicinity of the Baltic Power OWF Area remain in force (Figure 1.2):

- B-Wind (permit No. MFW/10/11);
- C-Wind (permit No. MFW/13/11);
- Bałtyk Środkowy III (Bałtyk III) (permit No. MFW/2/12);
- Bałtyk Środkowy II (Bałtyk II) (permit No. MFW/2a/13);
- Baltica 2 (permit No. MFW/4/12);
- Baltica 3 (permit No. MFW/5/12);
- Baltic II (permit No. MFW/5a/13).

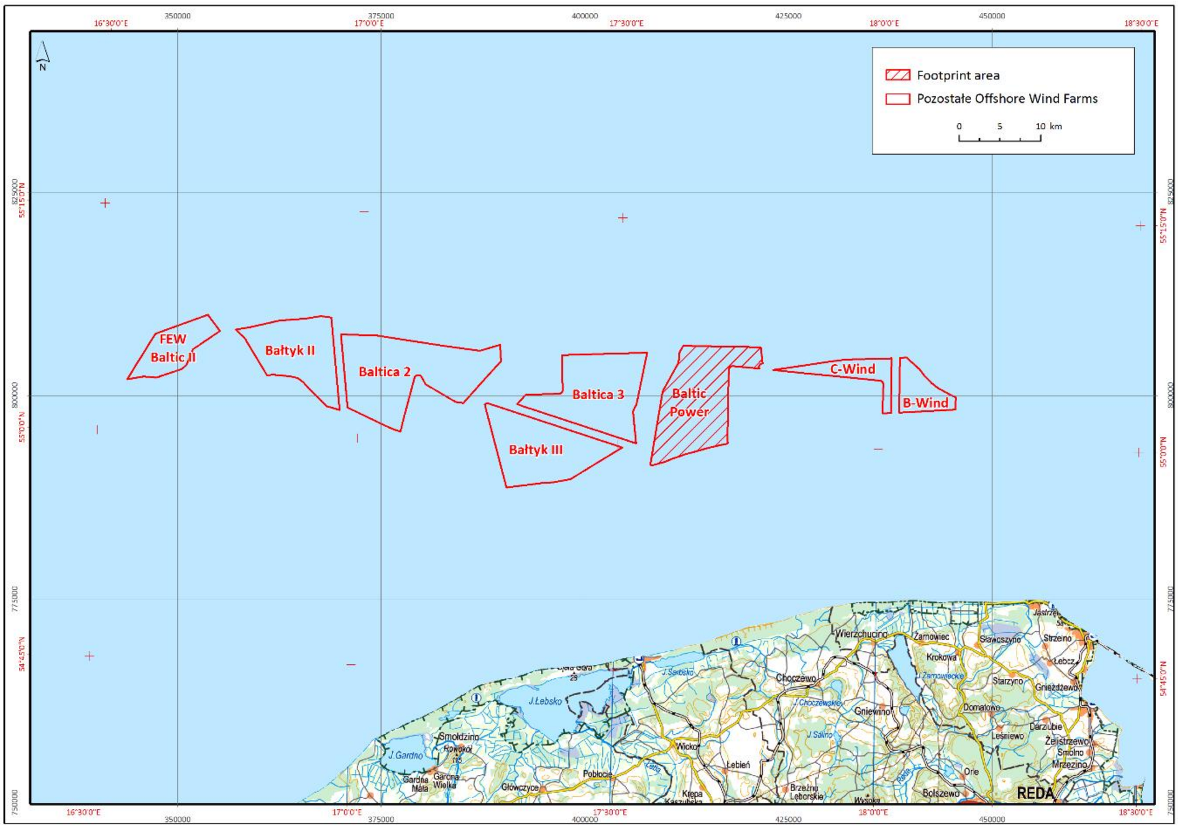


Figure 1.2. Location of the planned OWFs in the vicinity of the Baltic Power OWF Area [Source: own materials]

At the moment, none of the above-mentioned projects has been implemented. These projects are at different stages of development. Four of them have decisions on environmental conditions (Bałtyk II OWF, Bałtyk III OWF, Baltica 2 and Baltica 3 – as Baltica OWF). In the case of the B-Wind and C-Wind

OWFs, environmental surveys are in progress to prepare the Environmental Impact Assessment Report, while for the Baltic II OWF, the EIA Report was submitted to the Regional Directorate for Environmental Protection (RDEP) in Gdańsk.

In 2016, the Minister of Maritime Economy and Inland Navigation suspended the issue of permits for the construction of artificial islands, structures and devices until the SDPPMA has been adopted.

1.8 Methodology for the planned project impact assessment

When preparing this EIA Report, the results of environmental surveys and inventory surveys carried out in 2018−2020 for the Baltic Power OWF were used. The study also takes into account the results of the information meetings, which were used to clarify the issues of public interest and to develop the part of the report dedicated to the analysis of possible social conflicts.

The work was carried out in accordance with the method of preparation of the environmental impact assessment report, including:

- using the results of environmental surveys and environmental inventories;
- establishing the program and planning documents at international, national and regional level and the results of the environmental impact forecasts for these documents, which may have an impact on the planned project;
- the concept of the project, including the determination of activities in the following phases: construction, overlapping construction and exploitation period, exploitation and decommissioning, including the determination of risks to the environment and their potential effects;
- results of the information meetings.

When preparing the EIA Report, first of all, the following were used:

- guidelines, manuals and other materials concerning the preparation of the EIA Report;
- experience of the team of authors and generally applicable good practices.

Four phases of the planned project were considered in the EIA Report:

- construction:
- exploitation;
- construction and exploitation (overlapping over a period of several years);
- decommissioning.

The purpose of the EIA Report is to determine potential impacts of the planned project on the environment. The assessment is a study and analytical work performed by a team of specialists. When preparing the EIA Report, analyses of descriptive and cartographic materials were carried out, the impact assessment methodology was applied, as well as the interpretation of the results of the surveys and inventories conducted.

When preparing the Report, the main analyses regarded:

- technical and technological aspects of the planned project having effect on the size of the impact;
- environmental, spatial and social conditions of the planned project;
- variant preparation opportunities (in terms of location, technical, process, organisation and logistics);
- size and significance of potential environmental impacts;

- the possibility of avoiding and reducing adverse environmental impacts;
- the scope of monitoring.

The EIA Report contains an analysis of the planned project in terms of techniques and technologies applied as well as operating conditions. Among others, the information contained in the documentation of the planned project was used and the potential impact of similar activities that may accumulate was analysed.

On the basis of the data available, environmental surveys and environmental inventories, significant environmental, spatial and social conditions were determined. On this basis, potential impacts and risks related to the planned project were identified. The scope and reach of the expected environmental impact were also determined. Comparisons were made with analogous cases in terms of environmental conditions and the size and nature of impacts.

The approach used to assess the scale and significance of impacts results from the authors' experience gained during the environmental impact assessments of projects planned to be implemented in offshore areas, including OWFs.

The approach adopted allowed identifying comprehensive actions aimed at avoiding, preventing and limiting negative impacts related to the planned project.

Figure (Figure 1.3) presents a diagram of the methods of preparation of the EIA Report in relation to the data concerning the planned project and the environmental surveys conducted. Environmental surveys mean that the report on the impact of the planned project on the environment used both environmental surveys and environmental inventories carried out for the purpose of this document, as well as the results of other surveys, e.g. for projects located closest to the planned project, in connection with the development of such documents as protection plans for protected areas (resulting from environmental monitoring or monitoring/surveys carried out in connection with other activities or projects), available to the public or in literature.

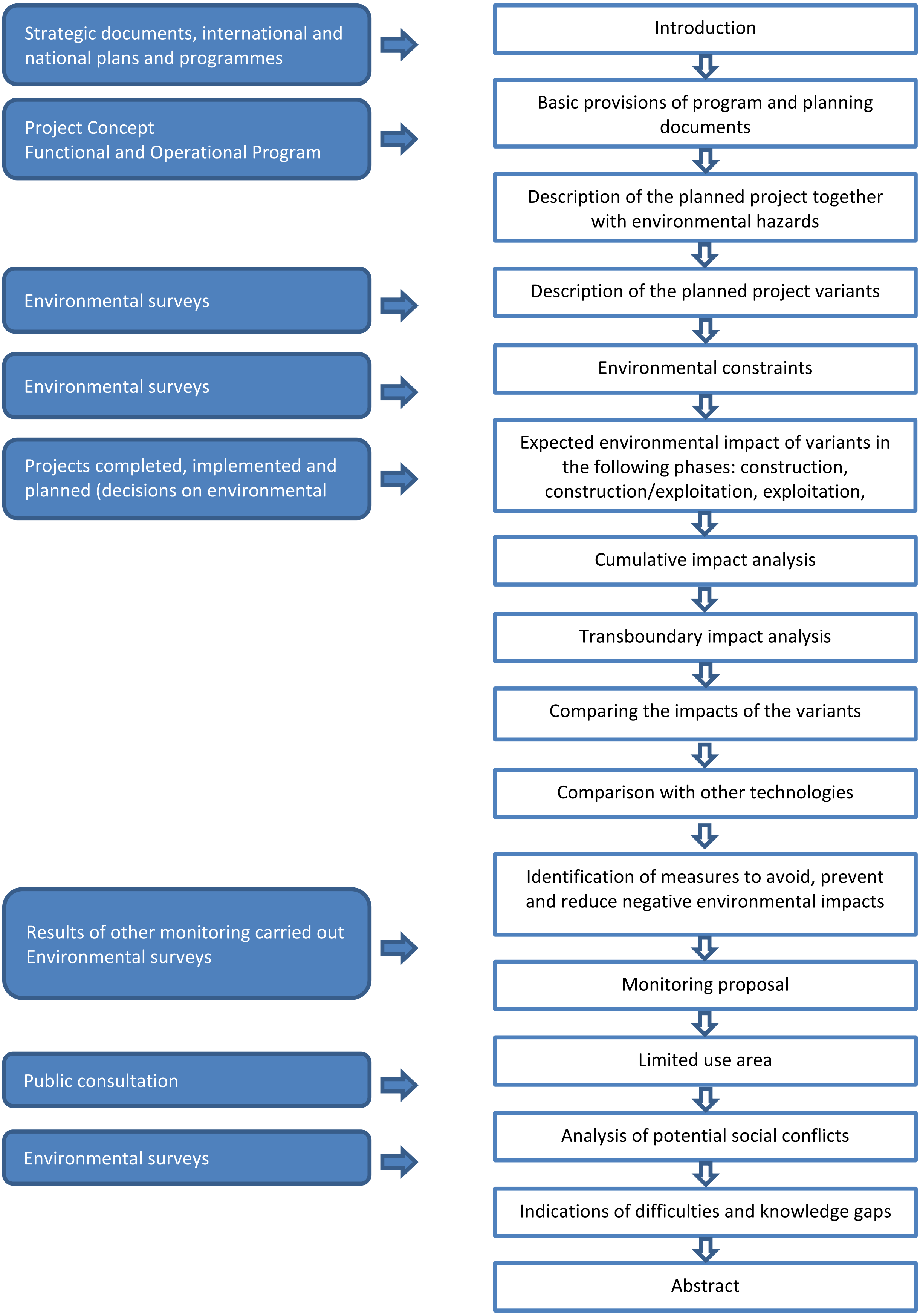


Figure 1.3. Outline of the Environmental Impact Assessment Report preparation [Source: own materials]

The table (Table 1.3) presents the characteristics of the marine environment surveys, which were carried out for the purpose of the preparation of the EIA Report. Detailed testing methods for individual elements are presented in the inventory reports constituting Appendix 1 to this Report.

Table 1.3. Characteristics of surveys of abiotic and biotic elements of the marine environment [Source: Baltic Power Sp. z o.o. data]

Type of surveys	**Date of surveys**	**Range of surveys**	**Scope of surveys**
Abiotic elements			
Geophysical surveys	01.2019–11.2019	Area (1 Mm)	Profiling (in profiles every 80 m): • Bathymetric (multibeam echosounder); • Sonar (side scan sonar); • Magnetometric; • Seismoacoustic and seismic (two sediment profilers operating at different frequencies, high and low). Visual inspection carried out using an ROV. Analysis of material collected during magnetometric, bathymetric and sonar profiling and visual inspections of selected objects. Collecting 72 core samples, in an even grid with an average density of 1 sample per 3 km². Measurement of thermal resistance *in situ* at 16 stations. Collecting 189 samples of surface sediments in an even grid with an average density of 1 sample per 1 km².
Meteorological surveys	01.2019–02.2020	Area (1 Mm)	Measurements using a weather buoy to measure meteorological conditions. Registration of: • Wind speed and direction; • Atmospheric pressure; • Air temperature and humidity.
Hydrological surveys	01.2019–02.2020	Area (1 Mm)	Measurements using two sets for the measurements of hydrological parameters (one under the weather buoy and one in the shallowest place of the OWF Area). Registration: • Wave height, period and direction; • Sea currents velocity and direction (in near-surface, middle and near-seabed layers); • Water temperature, turbidity and conductivity (at depths of 1, 4, 8, 16 m and above the seabed). Water sampling from the near-surface and near-seabed layers at 44 stations, including water sampling in standard vertical profiles at 6 stations. Measurement of water temperature and conductivity (during water sampling) using a CTD probe. Physico-chemical analyses of indicators in accordance with reference methods (or equivalent) specified in Appendix No. 7 to the Regulation of the Minister of Maritime Economy and Inland Navigation of 9 October 2019 on the forms and method of monitoring of surface and underground water bodies (Journal of Laws of 2019, item 2147).
Geochemical surveys	01.2019–07.2019	Area (1 Mm)	Collecting 190 samples of surface sediments (during the winter campaign) and 188 samples of surface sediments

Type of surveys	Date of surveys	Range of surveys	Scope of surveys
			(during the summer campaign) in an even grid with an average density of 1 sample per 1 km². Laboratory tests based on PN-EN-ISO standards or, in the absence thereof, in accordance with test procedures prepared by an accredited laboratory or applicable test methods.
Acoustic surveys	12.2018–01.2020	Area (2 Mm)	Ambient noise measurements using 1 hydrophone
Biotic elements			
Phytobenthos	06.2019	Area (1 Mm)	Analysis of bathymetric and sonar data. Visual inspection performed using an ROV on 11 transects, including 10 on the stony seabed and 1 on the sandy seabed. Analysis of video material.
Macrozoobenthos	05–06.2019	Area (1 Mm)	Collecting 200 quantitative samples from a soft bottom in an even grid with an average density of 1 sample per 1 km². Collecting 10 samples from the hard bottom, including 9 quantitative samples and 1 qualitative sample. Laboratory tests of: • Taxonomic composition; • Abundance; • Biomass.
Ichthyofauna	01.2019–10.2019	Area (1 Mm)	Acoustic monitoring using an echo sounder. Sampling (ichthyofauna) using pelagic trawls and sets of survey nets. Sampling (ichthyoplankton) using a Bongo net. Ichthyological analysis in terms of: • length and mass of specimens; • sex and gonadal maturity; • degree of stomachs filling; • age. Ichtyoplankton analysis in terms of: • taxonomic composition; • abundance; • larvae and fry lengths.
Marine mammals	12.2018–01.2020	Area (2 Mm)	Passive acoustic monitoring of porpoises using 5 underwater continuous porpoise detectors (C-PODs). Aerial observations at 5 transects.
Migratory birds	03.2019–11.2019	Area (2 Mm)	Visual observations, acoustic recordings and recordings using vertical and horizontal radars at 1 station.
Seabirds	10.2018–11.2019	Area (2 NM) and three areas: Słupsk Bank, South Central Bank, strip of coastal waters	Counting of birds sitting on the water and flying, along: • 4 transects in the OWF Area (2 NM); • 8 transects in the Natura 2000 site – Słupsk Bank (PLC990001); • 6 transects in the Southern Middle Bank Area; • 8 transects within the coastal waters strip.
Bats	04.2019–10.2019	Area (2 Mm)	Acoustic recording with the use of recorders at 2 stations and along 5 transects with a total length of 55 km.

Figure (Figure 1.4) presents an outline of the methodology for the project environmental impact assessment.

At the first stage of the assessment, the activities resulting from the implementation of the planned project in its individual phases, i.e. construction, exploitation and decommissioning, including the overlapping construction and exploitation phase, were specified. On the basis of environmental and inventory surveys carried out for the purposes of the EIA Report, the elements of the environment (receivers) which may be affected by these activities were also determined. At the second stage of the assessment, links between the sources of potential impacts and individual receivers were identified on the basis of literature and experience of experts.

Specific impacts have been assigned characteristics in four categories:

- nature of impacts (positive or negative);
- type of impacts (direct, indirect, secondary/simple, accumulated/reversible, permanent);
- impact range (local, regional) and determining whether the impact is transboundary;
- time range of impacts (short-term, medium-term, long-term, constant, temporary).

At the same time, the resistance of receivers to individual impacts in the cases of possible interaction between the impact and receiver was determined. Taking into account the characteristics of impacts assigned and the determined receiver resistance to them, the scale (size) of impacts, specific for individual relations between the impact and the receiver, was established. The size (scale) of the impact is described on a five-step scale: (1) negligible, (2) low, (3) moderate, (4) high and (5) very high.

Taking into account the prevalence of a given receiver occurrence, its significance and role in the environment, and, in particular, its conservation status, individual receivers, treated as an environmental resource, were assigned a value (significance), also determined on a five-step scale: (1) negligible, (2) low, (3) moderate, (4) high and (5) very high.

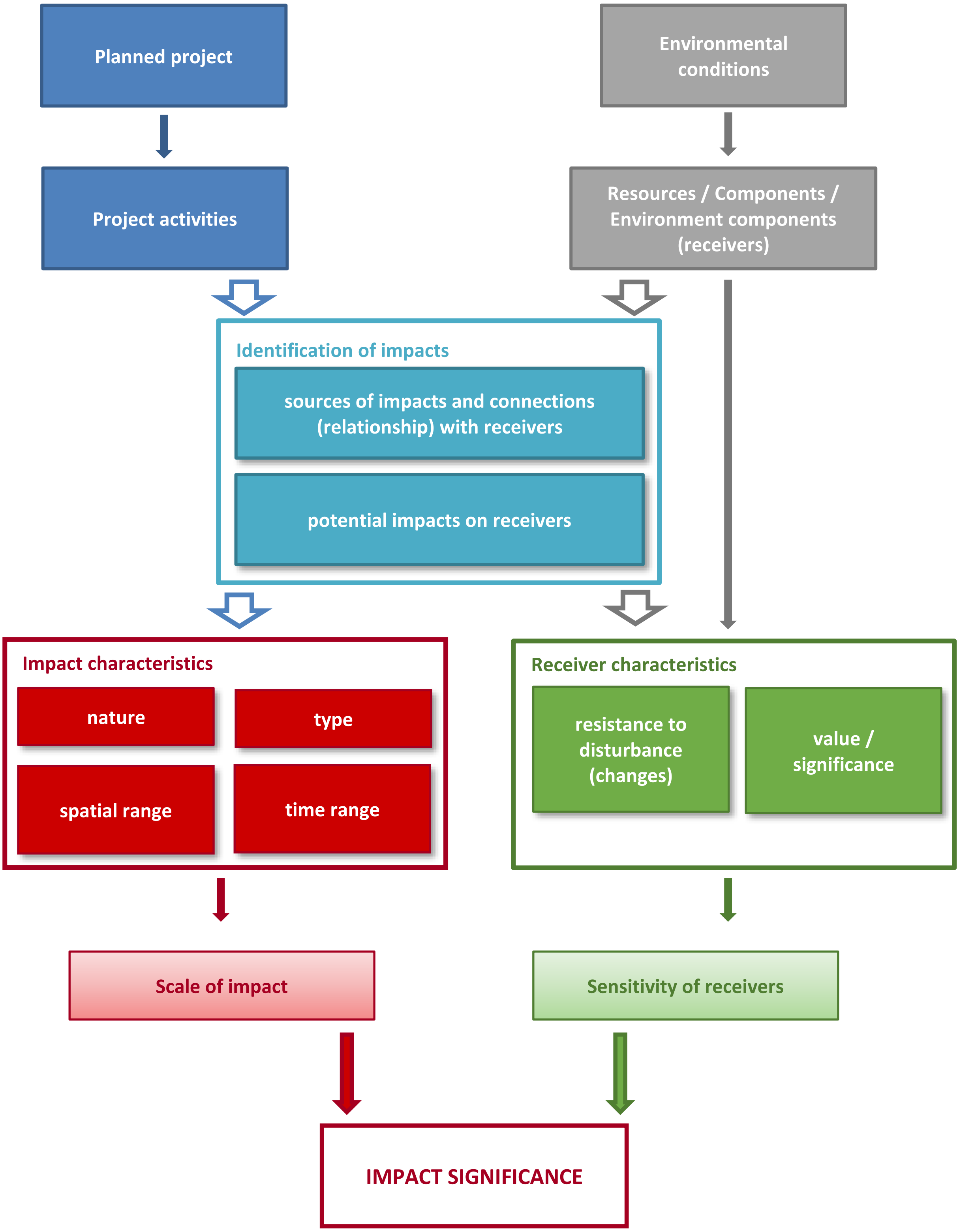


Figure 1.4. Outline of environmental impact identification and impact assessment, including the determination of impact significance [Source: own materials based on ESPOO REPORT (2017) [120]]

At the next stage of the assessment, taking into account the impact magnitude (scale) assigned and the receiver sensitivity, the significance of the impact was determined also on a five-step scale (Table 1.4):

- negligible impact;

- low impact;
- moderate impact;
- significant impact;
- substantial impact.

Table 1.4. Matrix defining the significance of the impact in relation to the scale of impact and the value of the resource [Source: own materials]

Impact significance		**Receiver sensitivity**				
		Negligible	**Low**	**Moderate**	**High**	**Very high**
Scale (size) of impact	Negligible	Negligible	Negligible	Negligible	Negligible	Low impact
	Low	Negligible	Negligible	Low impact	Low impact	Moderate
	Moderate	Negligible	Low impact	Low impact	Moderate	Moderate
	High	Negligible	Low impact	Moderate	Significant	**Substantial**
	Very high	Low impact	Moderate	Moderate	**Substantial**	**Substantial**

In accordance with the methodology of the environmental impact assessment described above, a significant impact may occur if a “very large” scale of impact is determined and at the same time at least a “high” sensitivity of the receiver and a “high” scale of impact with a “very high” sensitivity of the receiver is stated.

2 Description of the planned project

2.1 General characteristics of the planned project

2.1.1 Subject and scope of the project

The project in question is the construction and operation of the Baltic Power OWF with the total installed capacity not exceeding 1200 MW, together with the technical, measurement and survey as well as service infrastructure related to the preparatory, implementation and exploitation phases, located in the Polish exclusive economic zone (EEZ).

The scope of the project covers its implementation consisting of three main phases: construction, exploitation and decommissioning. The entire investment will consist of the following elements:

- wind power stations consisting of nacelles with rotors, towers and foundations or support structures anchored in the seabed or set on foundations on the seabed;
- offshore substations;
- internal power lines and telecommunications systems;
- measurement and survey station as well as accommodation and service station (optionally).

A detailed scope of the project parameters for the APV is presented in the table below (Table 2.1). A description of the variants considered in this document can be found in subsection 2.3.

Table 2.1. List of key project parameters in the Applicant Proposed Variant [Source: internal materials]

Parameter	**Unit**	**Value**
Total installed power (maximum)	MW	1200
Number of wind power stations	-	126
Rotor diameter (maximum)	m	260
Clearance between the rotor operation area and the water surface (minimum)	m	20
Structure height including the rotor (maximum)	m	330
Number of additional structures (maximum)	-	12
Diameter of the Gravity Based Structure (GBS) (maximum)	m	55
Seabed surface occupied by the Gravity Based Structure (GBS) (maximum)	m^2	2375
Length of cable routes in internal wiring (maximum)	km	600

The EIA Report is based on the concept of an envelope description of the project. This is due to the fact that offshore wind energy projects are considerably lengthy in time − in the case of offshore wind farms, investment processes last many years, often exceeding 10 years from the decision to begin preparations for the project to the beginning of construction. During that time, the technologies used in OWFs undergo significant changes the main direction of which is to reduce the environmental impact by increasing the efficiency of a power generation by a single wind power station and reducing their total number necessary to obtain the assumed OWF power. The existing and currently used wind power stations (with capacities from 3.6 MW to 9.5 MW) may not be available in production and for use in the perspective of the Baltic Power OWF implementation and the commencement of the first construction phase after 2024. Thus, the parameters of the project had to be described in such a way that it would allow, in the future, for taking advantage of technological progress and application of the solutions not worse than the ones existing at present.

The envelope concept means that in the case of the evaluation of a chosen parameter and the possibility of applying different technical solutions, the environmental impact assessment has been carried out for the solution which is potentially most burdensome to the environment. It has been assumed that if the most burdensome solution would not have a significantly negative impact on the environment, the remaining solutions as less burdensome, would also be acceptable. An example of an enveloping approach to the assessment can be the assessment of the foundation laying impact. The Gravity Based Structure (GBS) requires extensive work related to sediment transfer and it is the most burdensome solution in this respect, while installing a large-diameter monopile will generate the most noise. In the envelope concept, it has been assumed that the assessment will take into account the amount of sediment moved in the case of using a gravity based structure and the underwater noise generated in the case of piling a monopile. This means that the environmental impact assessment of the technology most burdensome for the given environmental element has been carried out. Such impacts are not likely to occur simultaneously – if the GBS is selected, the underwater noise will be much smaller, and if a monopile is selected, practically no sediment will be involved. This means that each foundation or support structure selected will lead to smaller impacts than the ones assumed in the EIA Report.

The main assumption of the envelope concept applied has been to determine which parameters of the Baltic Power OWF are significant for the scale of its impact, and consequently to determine the conditions for the project implementation in the decision on environmental conditions (DEC) as well as to ensure that its implementation will not cause significant environmental impact, regardless of the technology ultimately selected from among the ones considered in this Report.

In the construction phase, during the work on the OWF structure foundations, underwater noise will be generated. Its greatest intensity will be related to driving large-diameter monopiles with the use of a pile driver (it may reach momentary SPL values above 243.6 dB re 1 µPa at 1 m from the source). Taking into account that underwater noise generated at such a level may cause a significant negative impact on marine organisms (fish and mammals) subject to protection in the Natura 2000 site Ostoja Słowińska (PLH220023), the Applicant will apply relevant measures and technical solutions to reduce it.

Several concepts of Noise Reduction System (NRS) can be applied. Some of the solutions currently used include single and double air bubble curtains, noise barriers or cofferdam systems [28, 300]. Technological solutions regarding the NRS are in constant development. At present, it has not been determined which NRS concept will be implemented during piling related to the Baltic Power OWF implementation. The fundamental condition determining the selection of specific NRS solutions will be not to exceed the following values at the boundary of the Natura 2000 site Ostoja Słowińska (PLH220023) [297]:

- 140 dB re 1 $\mu Pa^2 s$ SEL_{cum} HF-weighted (HF-weighting function for marine mammals with high sensitivity to high frequency sounds – porpoise);
- 170 dB re 1 $\mu Pa^2 s$ SEL_{cum} PW-weighted (PW-weighting function for pinniped marine mammals – seals).

In the case of fish, the threshold value of a temporary shift of the auditory threshold (TTS) (1-h cumulative SEL) is 186 dB re 1 $\mu Pa^2 s$ SEL_{cum} [335], which will also remain within limits at the boundary of the Natura 2000 site Ostoja Słowińska (PLH220023) due to NRS application.

2.1.2 Location and the sea area taken by the project

Baltic Power OWF Area is located in the Polish EEZ, north of Łeba and Choczewo municipalities, 22.5 km from the shoreline (Figure 2.1). The area is described by the geographical coordinates indicated in the PSzW No. MFW/6/12, as amended, for Baltic Power Sp. z o.o. (Table 2.2). The Baltic Power OWF project will be executed in one operation or in stages within the area indicated in the PSzW No. MFW/6/12, as amended.

From the north and south, the Baltic Power Development Area (Baltic Power DA) (Figure 2.1, Table 2.3) will reach the boundary of the area with the PSzW No. MFW/6/12, as amended. The western boundary of the Baltic Power DA, in its northern section, will reach the boundary with the PSzW No. MFW/6/12, as amended, and then it will run within 500 m from the boundary of PSzW No. MFW/6/12, as amended, to the turn point. Further, the western boundary of the Baltic Power DA will extend from the boundary of the area with the PSzW No. MFW/6/12, as amended, down to the south-western point of the area with the PSzW No. MFW/6/12, as amended. The eastern boundary of the Baltic Power DA, in its north-eastern section, will run along the boundary of the area with PSzW No. MFW/6/12, as amended, and then within 500 m from the boundary with PSzW No. MFW/6/12, as amended.

The surface of the Baltic Power OWF Area is 131.08 km^2, while the surface of the Baltic Power DA is 113.72 km^2.

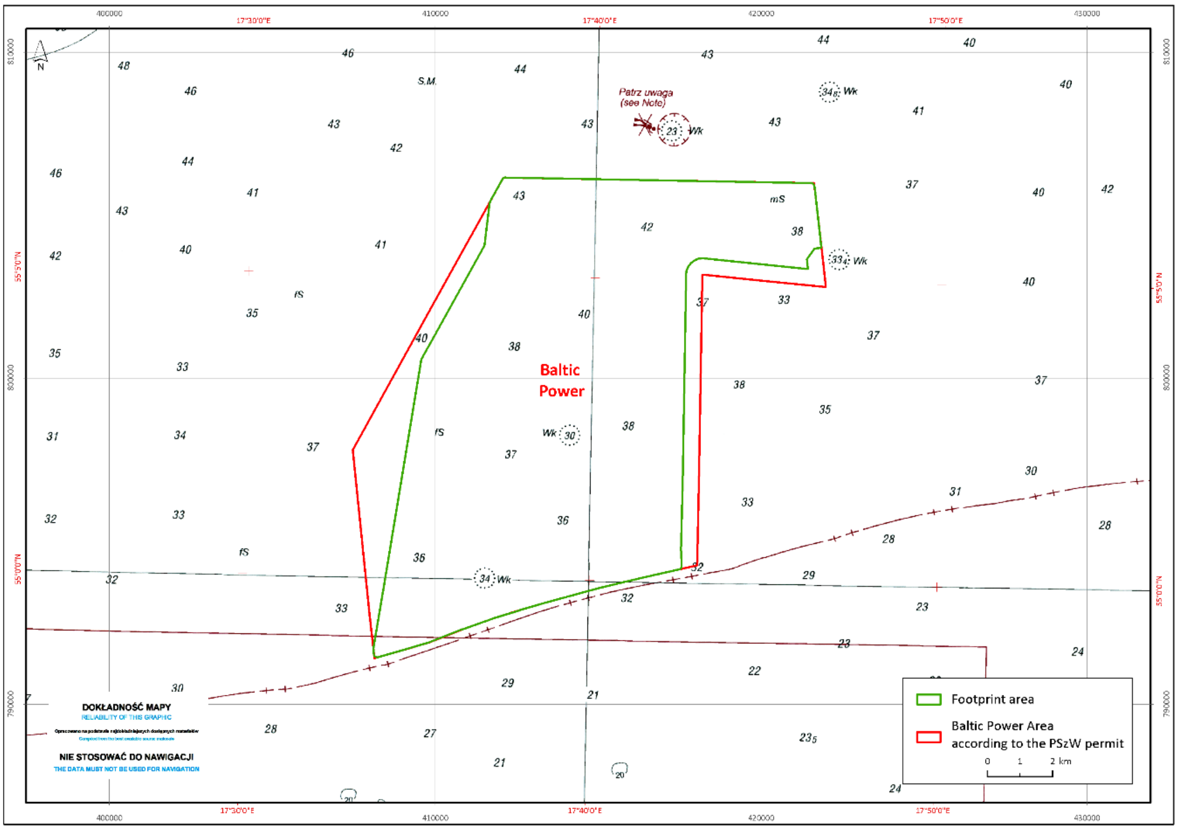


Figure 2.1. Location of the project in reference to the issued decision PSzW No. MFW/6/12, as amended. [Source: internal materials]

Table 2.2. Geographical coordinates of the Baltic Power OWF Area according to the PSzW No. MFW/6/12, as amended, for Baltic Power Sp. z o.o. [Source: internal materials]

Point no.	**Geographical coordinates**			
	PUWG 1992 [m]		**WGS 84 [DD°MM'SS.SSS"]**	
	Easting	**Northing**	**Longitude**	**Latitude**
1	421638	805984	17°37'17.884" E	55°06'39.036" N
2	421918	803498	17°46'16.298" E	55°06'39.087" N

Point no.	Geographical coordinates			
	PUWG 1992 [m]		WGS 84 [DD°MM'SS.SSS"]	
	Easting	Northing	Longitude	Latitude
3	421999	802799	17°46'34.607" E	55°05'18.813" N
4	420274	802972	17°46'39.823" E	55°04'56.239" N
5	418208	803180	17°45'02.381" E	55°05'00.851" N
6	418150	800029	17°43'05.639" E	55°05'06.379" N
7	418099	796888	17°43'05.640" E	55°03'24.394" N
8	418055	794826	17°43'06.000" E	55°01'42.750" N
9	418044	794268	17°43'05.640" E	55°00'36.000" N
10	416271	793861	17°43'05.643" E	55°00'17.953" N
11	415031	793575	17°41'26.248" E	55°00'03.734" N
12	413286	793090	17°40'16.789" E	54°59'53.696" N
13	412594	792888	17°38'39.074" E	54°59'36.946" N
14	411843	792654	17°38'00.368" E	54°59'29.961" N
15	410854	792313	17°37'18.387" E	54°59'21.910" N
16	409796	791893	17°36'23.135" E	54°59'10.259" N
17	408816	791612	17°35'24.074" E	54°58'55.990" N
18	408132	791417	17°34'29.277" E	54°58'46.231" N
19	407992	792719	17°33'51.033" E	54°58'39.486" N
20	407469	797802	17°33'41.652" E	54°59'21.502" N
21	409899	802194	17°33'06.288" E	55°02'05.617" N
22	421638	805984	17°37'17.884" E	55°06'39.036" N

Table 2.3. Geographical coordinates of the Baltic Power DA [Source: internal materials]

Point no.	Geographical coordinates			
	PUWG 1992 [m]		WGS 84 [DD°MM'SS.SSS"]	
	Easting	Northing	Longitude	Latitude
1	412139	806156	17°37'20.084" E	55°06'38.927" N
2	412167	806159	17°37'21.617" E	55°06'39.039" N
3	421541	805986	17°46'10.854" E	55°06'39.088" N
4	421569	805982	17°46'12.414" E	55°06'38.974" N
5	421586	805975	17°46'13.405" E	55°06'38.773" N
6	421602	805966	17°46'14.322" E	55°06'38.480" N
7	421616	805954	17°46'15.140" E	55°06'38.103" N
8	421629	805940	17°46'15.834" E	55°06'37.651" N
9	421638	805924	17°46'16.386" E	55°06'37.139" N
10	421645	805906	17°46'16.779" E	55°06'36.580" N
11	421649	805885	17°46'17.026" E	55°06'35.894" N
12	421656	805824	17°46'17.476" E	55°06'33.926" N
13	421861	804006	17°46'30.866" E	55°05'35.220" N
14	421646	803972	17°46'18.796" E	55°05'33.988" N
15	421413	803651	17°46'05.930" E	55°05'23.472" N

Point no.	Geographical coordinates			
	PUWG 1992 [m]		WGS 84 [DD°MM'SS.SSS"]	
	Easting	Northing	Longitude	Latitude
16	421445	803357	17°46'08.018" E	55°05'13.969" N
17	418258	803678	17°43'07.973" E	55°05'22.502" N
18	418199	803680	17°43'04.625" E	55°05'22.547" N
19	418160	803678	17°43'02.412" E	55°05'22.451" N
20	418121	803673	17°43'00.227" E	55°05'22.257" N
21	418082	803664	17°42'58.067" E	55°05'21.964" N
22	418045	803653	17°42'55.946" E	55°05'21.572" N
23	418008	803638	17°42'53.893" E	55°05'21.088" N
24	417973	803621	17°42'51.913" E	55°05'20.512" N
25	417939	803602	17°42'50.035" E	55°05'19.856" N
26	417907	803579	17°42'48.236" E	55°05'19.110" N
27	417876	803554	17°42'46.544" E	55°05'18.286" N
28	417848	803527	17°42'44.971" E	55°05'17.388" N
29	417809	803482	17°42'42.833" E	55°05'15.898" N
30	417787	803450	17°42'41.617" E	55°05'14.858" N
31	417767	803416	17°42'40.520" E	55°05'13.737" N
32	417750	803381	17°42'39.597" E	55°05'12.593" N
33	417735	803344	17°42'38.820" E	55°05'11.388" N
34	417724	803306	17°42'38.216" E	55°05'10.162" N
35	417716	803268	17°42'37.786" E	55°05'08.925" N
36	417710	803229	17°42'37.522" E	55°05'07.650" N
37	417708	803189	17°42'37.434" E	55°05'06.363" N
38	417650	800037	17°42'37.455" E	55°03'24.361" N
39	417599	796898	17°42'37.835" E	55°01'42.767" N
40	417553	794756	17°42'37.489" E	55°00'33.458" N
41	417559	794536	17°42'38.014" E	55°00'26.319" N
42	417573	794244	17°42'39.147" E	55°00'16.905" N
43	417571	794226	17°42'39.051" E	55°00'16.323" N
44	417566	794209	17°42'38.791" E	55°00'15.758" N
45	417554	794185	17°42'38.110" E	55°00'14.975" N
46	417542	794171	17°42'37.479" E	55°00'14.517" N
47	417529	794159	17°42'36.726" E	55°00'14.124" N
48	417513	794150	17°42'35.871" E	55°00'13.808" N
49	417488	794140	17°42'34.450" E	55°00'13.493" N
50	416271	793861	17°41'26.248" E	55°00'03.734" N
51	415031	793575	17°40'16.789" E	54°59'53.696" N
52	413286	793090	17°38'39.074" E	54°59'36.946" N
53	412594	792888	17°38'00.368" E	54°59'29.961" N
54	412594	792888	17°38'00.357" E	54°59'29.959" N
55	412594	792888	17°38'00.357" E	54°59'29.959" N

Point no.	Geographical coordinates			
	PUWG 1992 [m]		WGS 84 [DD°MM'SS.SSS"]	
	Easting	Northing	Longitude	Latitude
56	412589	792886	17°38'00.089" E	54°59'29.907" N
57	411843	792654	17°37'18.387" E	54°59'21.910" N
58	410854	792313	17°36'23.135" E	54°59'10.259" N
59	410833	792305	17°36'21.957" E	54°59'09.975" N
60	409793	791892	17°35'23.886" E	54°58'55.958" N
61	409025	791673	17°34'40.967" E	54°58'48.343" N
62	408258	791453	17°33'58.052" E	54°58'40.724" N
63	408258	791453	17°33'58.051" E	54°58'40.724" N
64	408231	791449	17°33'56.539" E	54°58'40.572" N
65	408204	791451	17°33'55.009" E	54°58'40.638" N
66	408178	791460	17°33'53.554" E	54°58'40.920" N
67	408155	791476	17°33'52.264" E	54°58'41.398" N
68	408143	791489	17°33'51.535" E	54°58'41.813" N
69	408128	791512	17°33'50.690" E	54°58'42.549" N
70	408122	791529	17°33'50.313" E	54°58'43.097" N
71	408118	791547	17°33'50.099" E	54°58'43.674" N
72	408118	791547	17°33'50.099" E	54°58'43.675" N
73	408103	791697	17°33'49.040" E	54°58'48.511" N
74	408105	791723	17°33'49.153" E	54°58'49.374" N
75	408110	791740	17°33'49.429" E	54°58'49.929" N
76	408411	793548	17°34'04.236" E	54°59'48.600" N
77	409579	800584	17°35'01.987" E	55°03'36.989" N
78	409823	801023	17°35'15.190" E	55°03'51.362" N
79	409823	801023	17°35'15.191" E	55°03'51.364" N
80	411514	804074	17°36'47.128" E	55°05'31.148" N
81	411679	805384	17°36'54.939" E	55°06'13.641" N
82	411682	805400	17°36'55.109" E	55°06'14.176" N
83	411692	805424	17°36'55.626" E	55°06'14.934" N
84	411709	805455	17°36'56.563" E	55°06'15.948" N
85	412069	806103	17°37'16.141" E	55°06'37.149" N
86	412085	806125	17°37'17.030" E	55°06'37.874" N
87	412106	806142	17°37'18.204" E	55°06'38.450" N
88	412122	806151	17°37'19.109" E	55°06'38.734" N

2.1.3 Stages of the project implementation

In order to:

- mitigate the risk of failure to meet the time frames indicated in the Act of 21 March 1991 on maritime areas of the Republic of Poland and maritime administration (Journal of Laws of 1991, No. 32, item 131, as amended) to maintain the PSzW No. MFW/6/12, as amended, for Baltic Power Sp. z o.o. in force;

- optimise economically the entire project;
- enable the comprehensive contracting of the necessary services and supplies;
- consider the limitations in the access to essential services and supplies (specialist vessels, port infrastructure and other components in the supply chain) related to the possible implementation of similar investment plans in the offshore wind energy sector by other entities,

the Applicant allows for the implementation of the project in a continuous process as well as in stages.

2.2 Description of technological solutions

The section below provides information on the most frequently used or planned technological solutions for the process of electricity generation in OWE. It should be noted that the most common systems currently used, based on alternating current generation and transmission, can be replaced by the Applicant by the systems based on direct current generation and transmission, or any combination of the two. At the stage of the EIA Report submission, the Applicant does not exclude the use of either of these technologies.

2.2.1 Description of the production process

Wind power stations are devices designed for converting kinetic energy of wind into electricity by means of a wind-driven rotor driving a power generator. The mechanical energy of the rotor is converted into a low-voltage AC electricity, which is usually converted to a medium voltage and then to a high voltage for further transmission.

Due to the location conditions, wind farms installed in maritime areas are built as complexes of individual wind power stations together with associated infrastructure (e.g. measurement and survey infrastructure) designed to deliver the electricity produced to an onshore substation or to monitor the availability of the OWF (Figure 2.2).

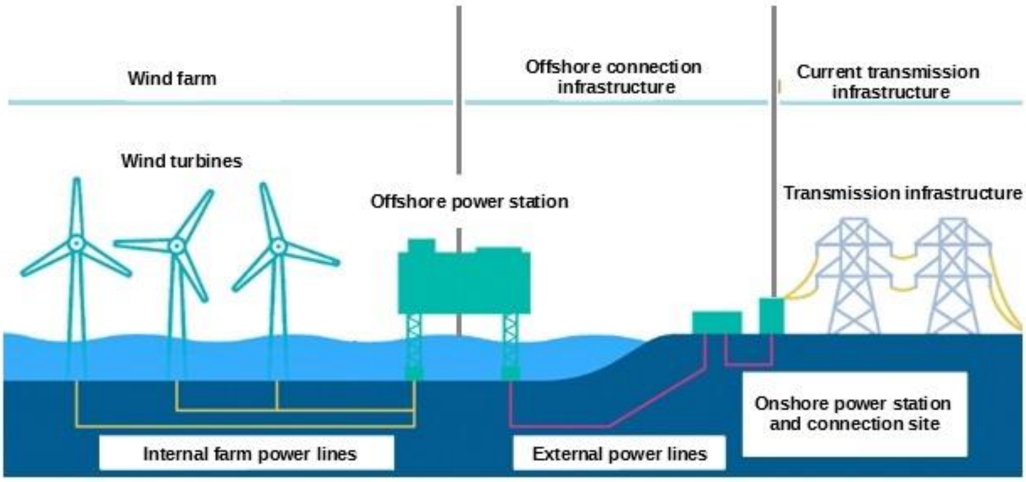


Figure 2.2. Basic elements of the offshore wind farm along with the transmission infrastructure [Source: internal materials]

Wind power plants do not require the supply of other fuels and raw materials to produce electricity. Properly operated, they do not generate environmental pollution. The demand for electricity, in small amounts, occurs only in the case of windless weather. The demand for raw materials and energy, similarly to other energy installations, is related to the process of construction and installation of structural elements of individual wind farm components (materials used for manufacturing, fuels and other materials necessary in the construction phase), operation of service units and decommissioning (fuels and materials).

2.2.2 Description of the technological solutions for individual elements of the project

The offshore wind farm consists of four main components, connected functionally and structurally:

- wind power station;
- foundations or support structures;
- connection infrastructure;
- non-productive infrastructure.

Individual components of an OWF are described below.

2.2.2.1 Wind power station

The wind power station is an essential component of the wind farm. It comprises three main structural elements, each with a with specific function: the tower, the nacelle and the rotor (Figure 2.3).

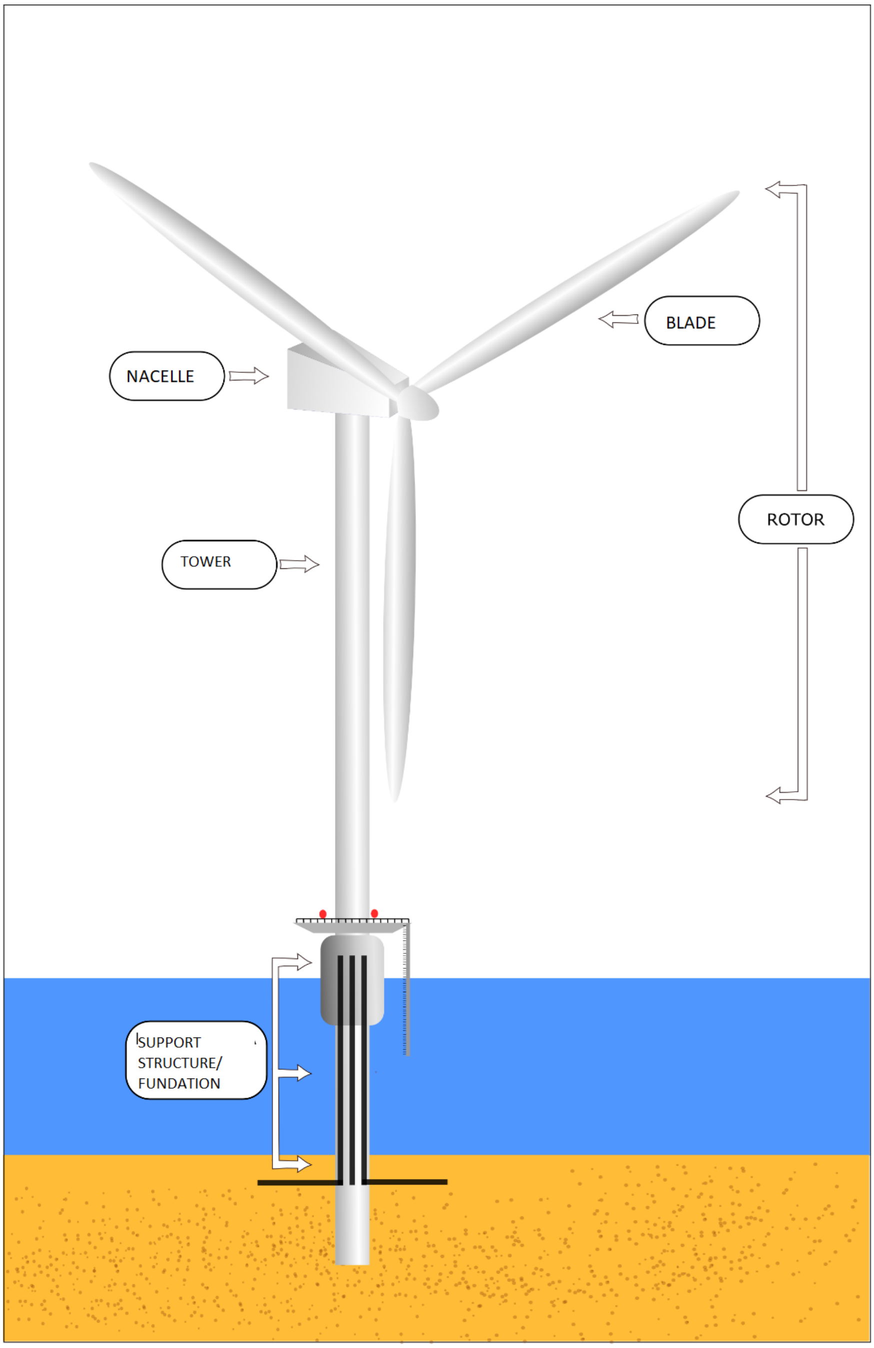


Figure 2.3. Schematic drawing of an offshore wind farm together with a support structure [Source: own materials]

The **tower** is a structural element connecting the nacelle with the support structure or the foundation. It is usually a steel tubular structure narrowing upwards. Its size and weight are adapted to the specific project and depend on the parameters of the other elements of the wind power station, type of support structure or foundation and the environmental conditions at the site. Currently used OWF towers can exceed the height of 100 m and weight of ca. 600 tonnes. In addition to its basic support function, the tower provides the foundation for laying control cables of the wind power station, power cables as well as other installations and devices necessary for the proper operation of the system. Moreover, the tower can feature internal and external platforms ensuring service teams' access to both the nacelle and the elements of the tower itself.

The **nacelle** constitutes a key component of a wind power station. It consists of drive system devices and a housing protecting it against weather conditions (Figure 2.4). The drive system ensures the conversion of rotational energy from the rotor to three-phase alternating current. The main components of the drive system are a turbine, a rotating shaft (possibly with a gearbox) and a generator. The generator produces electricity as a result of electrical induction, placing moving parts in a magnetic field. In the case of gearless turbines, the rotation of the rotor is transferred directly to the generator. This solution is characterised by lower failure rate of the whole system.

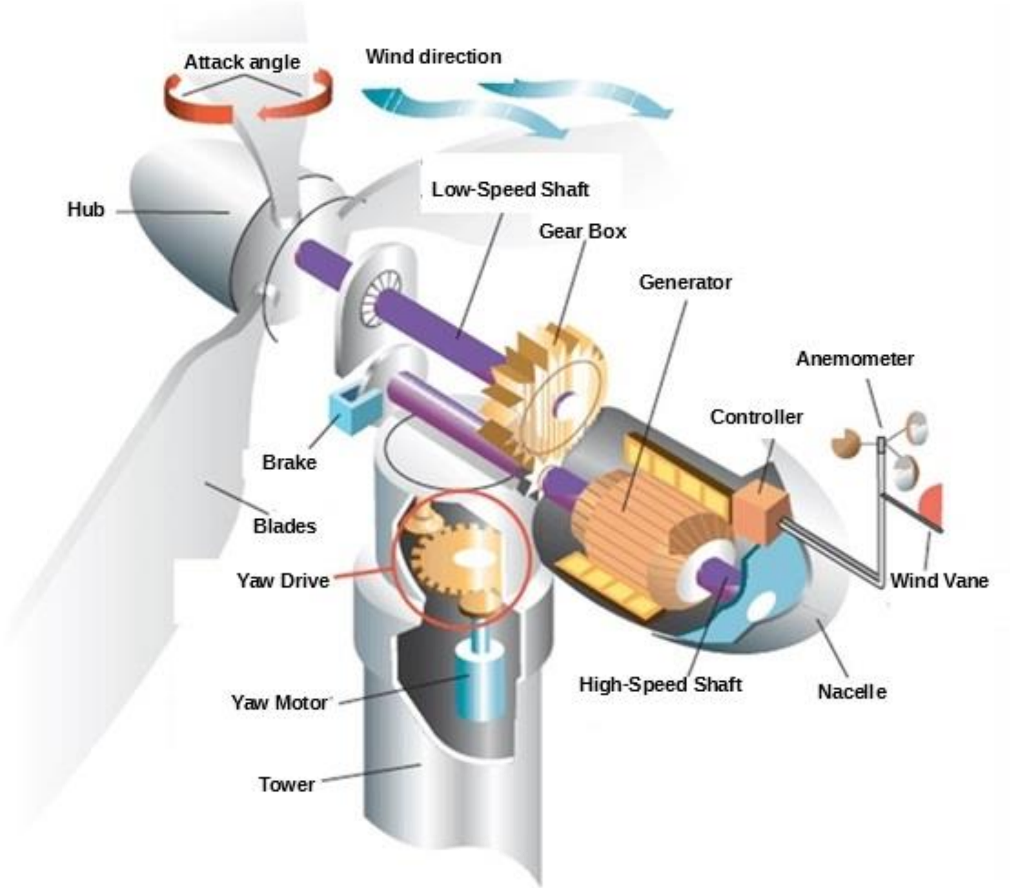


Figure 2.4. Schematic drawing of a nacelle with a gear drive system [Source: Areva]

OWF nacelles can also feature helicopter landing pads. The nacelle is assembled on land, transported as a complete unit and installed on the tower of the wind power station.

The last essential element of the wind power station is the **rotor**, which consists of blades and a hub. Under the influence of wind, the rotor rotates, capturing and transferring its energy to other parts of the nacelle. The blades are made of composite materials (glass fibre, carbon fibre, epoxy or polyester resins). They are equipped with electric discharge protection systems. The power of a wind turbine depends largely on the size of the rotor. In the rotors currently designed, the longest OWE blades reach over 100 m (e.g. for the Haliade-X 12 MW turbine).

2.2.2.2 Supporting structures with foundations

The tower of the wind power station that is not a floating structure is installed on a support structure or foundation, which is permanently attached to the seabed. During the installation process, the support structure with the foundation is set up first, followed by the wind power station. The support structure or foundation is primarily designed to ensure:

- adequate rigidity and strength of the wind power station;
- support for wiring systems;
- connection of the wind power station to the seabed;
- effective installation of the wind power station.

Selection of the appropriate type of support structure or foundation depends on the size and weight of the wind power station on the one hand, and on the other hand on the environmental conditions prevailing in the OWF Area, including, primarily, the depth of the sea and geological conditions of the seabed. Other important factors determining the type of support structure or foundation include environmental conditions (wave motion, currents, ice cover, biotic characteristics) and the economic aspect.

Depending on the how they impact the seabed, support structures or foundations can be divided into two categories:

- permanently and directly fixed to the seabed;
- floating, moored to the seabed through anchoring systems.

Support structures or foundations that can be permanently attached to the seabed in the Baltic Power OWF Area include: large-diameter monopile, jacket structure, tripod structure and GBS or others, the impacts of which will remain within the envelope concept of the project (Figure 2.5). Floating support structures are also possible.

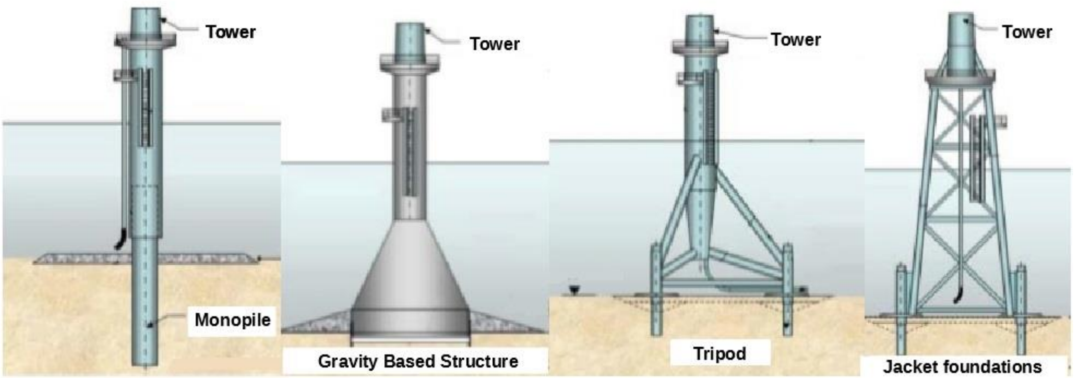


Figure 2.5. Selected types of support structures with bottom-fixed foundations [Source: own materials, based on Foundation for Sustainable Energy, Offshore wind energy – an opportunity for the development of maritime industry and coastal regions – conference material, Słupsk 2013 (https://fnez.pl/biblioteka-fnez/)]

Monopile foundation (large-diameter pile) is the most commonly adopted supporting structure in OWFs. It is a simple steel structure produced from cylindrical sections welded together. Its widespread application results from the geological conditions of the North Sea seabed, which enable the installation of such foundations. The length of the structure can reach up to 80 m. The installation of this type of foundation consists in driving or drilling them into the seabed to the appropriate depth. A transition piece is then installed on the part of the foundation or support structure extending above the sea level and the wind tower is installed on it afterwards. The tower can also be installed directly on the foundation.

Advantages of the large-diameter monopile include the simplicity of construction and installation as well as versatility of application. Disadvantages of this foundation are the limited possibilities of removal from the seabed after the conclusion of the wind farm operation phase, as well as the impact of underwater noise on marine animals while driving the structure into the seabed.

The diameter of the largest foundations applied thus far is 7.8 m and their weight is 1302.5 t. They were installed on the Veja Mate OWF in the North Sea, in the German EEZ. At present, the production capacity of the plants producing these structures is up to 10 m diameter (depending on the availability of sheet rolling equipment). Structures of this size are referred to as XXL monopiles.

Jacket foundations are composed of numerous elements welded together. The base of this structure is square or triangular in shape and its legs are fixed to the seabed with piles. Special skirt pile sleeves can be used for this purpose at the foundation base.

The advantage of jacket foundations over other types of support structures is their lower weight, wider spectrum of applications (not only in relation to the sea depth but also geological conditions) and less need for protection against washing out of sediments around them. Moreover, such foundations may be used for other structures within the OWF Area, including heavier structures such as power stations (e.g. the 400 MW BorWin1 station in the North Sea, weighing 3200 t). Disadvantages include a complicated structure requiring welding of many elements together, more difficult transport and more complicated process of fixing the foundation to the seabed.

Tripod is a relatively lightweight steel support structure consisting of three tubes at the base of the foundation and a central column projecting above the water surface. The base of each of the tubes is fixed to the seabed with piles – to a depth of 10 to 20 m. Each time, the width of the base and the depth of piling into the seabed is adjusted to the geological conditions.

The foundation ensures good resistance and overall rigidity. It is suitable for use on most seabed types with the exception of seabeds characterised by soft sediments. Disadvantages of the tripod are the complicated and hence expensive structure and the limited possibilities of removal in the decommissioning phase.

Gravity Based Structure (GBS) is made of concrete or steel and can be filled e.g. with rock material or sand to increase its weight, which can reach several thousand tonnes. It consists of a heavy base and a steel or concrete core. The mass counteracts aero and hydrodynamic loads. The base of the foundation can be equipped with a so-called skirt driven into the seabed to prevent lateral movements. The installation of such a support structure usually requires levelling works on the seabed.

Gravity Based Structures are characterised by low construction cost, easy installation (they can be towed to the installation site), no corrosion protection (in the case of concrete structures). The disadvantage, however, is the limitation concerning the depth of installation.

Floating support structures constitute a separate type of support structures, compared to the ones described above. Depending on the method of stabilisation, four types of floating support structures can be distinguished (Figure 2.6):

- barge – a structure floating on the water surface, made of steel or concrete;
- semi-submersible – consisting of several connected buoyancy tanks, which ensure the buoyancy of the whole structure, thus, balancing aero- and hydrodynamic loads; in some concepts active ballast systems are used;

- spar – a cylindrical structure that keeps the centre of buoyancy above the centre of gravity, providing little resistance to wave loads, thus, creating simple geometry with good stability;
- tension-leg platform – a partially submerged structure anchored to the seabed by means of permanently tensioned mooring ropes.

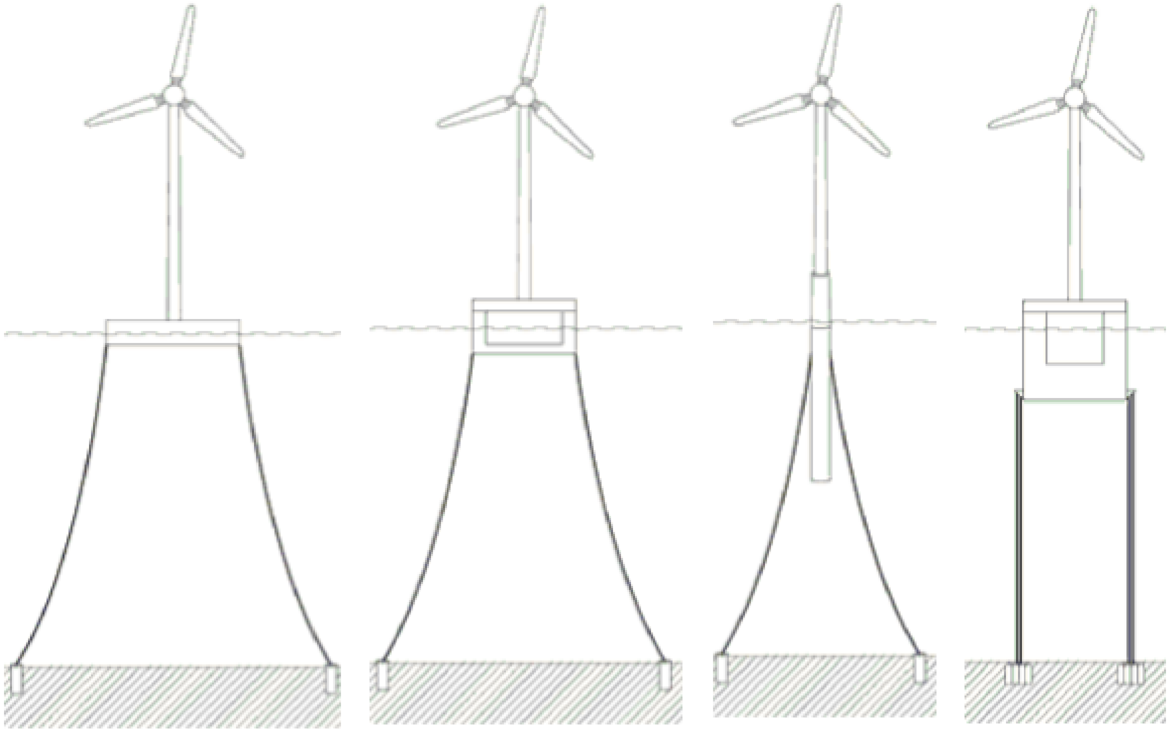


Figure 2.6. Types of floating support structures [Source: internal materials, based on https://rules.dnvgl.com/docs/pdf/DNVGL/ST/2018-07/DNVGL-ST-0119.pdf]

Unlike support structures permanently fixed to the seabed, floating support structures require dynamic connection cables, designed to withstand mechanical loads, for the purpose of connecting the floating structure to the internal network.

2.2.2.3 Connection infrastructure

The OWF connection infrastructure comprises:

- power lines (internal cabling);
- power substations.

OWF **inner array cables** connect wind power stations with substations located within the wind farm area.

Inner array cables mostly operate at 33/66 kV, which is a commonly used standard in the offshore wind energy sector. In most cases, three-core cables are used, i.e. consisting of three insulated conductors (copper or aluminium) often also equipped with optoelectronic cables. Single-core cables are also available.

Inner array cables of the OWF are mainly extruded cables, among which three types can be distinguished, depending on the type of insulation:

- EPR – the insulator is ethylene-propylene rubber; in this cable type, dielectric losses are higher than in the case of cables based on polyethylene, which limits their use to cables with an operating voltage of 150 kV; however, they are flexible and resistant to external conditions, with an operating temperature up to 90°C (130°C in emergency conditions);

- polyethylene – the insulator is polyethylene, which is characterised by low dielectric losses; it can be used in high voltage cables; the operating temperature of cables with this insulator type is limited to 80°C;
- XLPE (cross-linked polyethylene) – the insulator is polyethylene, which is subject to the process of cross-linking; as in the case of rubber vulcanization, polymer chains cross link into a lattice formation; they can be used for voltages up to 500 kV, at an operating temperature of up to 90°C.

An example of a three-core cable is presented below (Figure 2.7).

1. conductor (copper or aluminium) designed for the transmission of electricity

2. extruded conductor screening

3. insulation – XLPE (cross-linked polyethylene) or EPR (ethylene-propylene rubber)

4. semi-conductive screening

5. screen made of copper wire with a moisture swelling agent (to prevent longitudinal movement of moisture in case of damage)

6. laminated aluminium sheath

7. optical fibres (optional) for data transfer

8. polypropylene fillers

9. binder tapes

10. armour bedding – polypropylene strings

11. armour made of galvanised steel braiding wire for protection against mechanical damage

12. polypropylene stripe with bituminous compound

Figure 2.7. Three-core AC cable [Source: Baltic Power Sp. z o.o. data]

Given the development of wind power stations with increasing nominal capacity, 66 kV voltage is used more and more often. In the specifications of some power stations, manufacturers of wind power stations directly indicate that 66 kV transformers will be used. This concerns, among others, the MHI Vestas V164-10.0 wind power station (for MHI Vestas V164-9.5 MW the manufacturer indicates 33 or 66 kV options) and the GE Haliade-X 12 MW wind turbine.

Substations, which include substations and converter stations (Figure 2.8), are designed to transform and transfer the energy generated by wind power stations to land in the most efficient manner. This process can include increasing the voltage, providing reactive power compensation and converting alternating current to direct current. Among these, the following types can be distinguished:

- collection substations;
- converter stations AC/DC and DC/AC.

Substations are designed to increase the voltage of current from wind power stations (usually 33/66 kV) to a transmission level (even up to 400 kV), which is expected to reduce losses, increase transmission capacity or enable reduction of the conductor cross-section in cables.

The basic components of a substation include:

- transformers – the fundamental element designed to change the voltage;
- auxiliary transformers – they are used to provide power supply for the station equipment;
- grounding transformers – they are used to obtain an artificial zero point in networks grounded by a resistor or in compensated networks;
- high and medium voltage switchgear – used to connect, break and distribute electrical circuits;
- back-up generators – provide power supply in case of failure;
- chokes and capacitors to compensate for reactive power;
- AC filters – elements responsible for transmitting or blocking signals within a specific frequency range or containing specific overtones.

Most of the stations are unmanned but there are also service stations equipped with welfare facilities and equipment necessary for the crew.

Figure 2.8. Offshore substation at Walney Phase 1 OWF [Source: https://www.isc.dk/en/walney-i-ii-vindmoellepark/]

Substations can be installed on support structures, just like wind power stations. One OWF may be operated by several collection stations, and one station may be equipped with several transformers. An export cable and a fibre-optic connection can be routed out from each station.

The weight of substations ranges from about 800 to about 1500 t. For example, an AC substation with two transformers with a total power of 300 MVA has the following dimensions: width − 30 m, length − 30 m, height − 15 m and weight of about 1500 t, plus the foundation which weighs *ca.* 800 t. In the case of stations equipped with three transformers, the weight of the platform may even exceed 2000 t.

Converter stations are designed to convert alternating current (AC) to direct current (DC). Next, the current is transmitted over considerable distances to a substation on land, where it is converted from DC to AC and then sent to the NPS. The main structural elements of converter stations are analogous to those of the substations; the differences concerning mainly the electrical system.

2.2.2.4 Non-productive infrastructure

As part of the Baltic Power OWF implementation, it is possible to build (optionally) two platforms not directly related to power generation:

- measurement and survey platform;
- accommodation and service platform.

The former will be used for conducting measurements, mainly meteorological and hydrological. It will house test and measurement equipment as well as instruments for data recording and transmission.

Offshore accommodation and service platforms or helicopter platforms are used as a local base for all activities related to an OWF construction, operation, maintenance and finally decommissioning. In addition to their basic functions, they can also contain additional systems, including electrical systems. Platforms of this type may significantly differ in size and capabilities. Existing options include: a large sea base with spacious accommodation facilities and significant logistic capabilities, relatively small platforms designed primarily as a local stopping point with a possibility of landing a helicopter or medium-sized platforms also combining the functions of other platforms, e.g. transformer units. Accommodation facilities are intended for crews working at sea, usually on a shift basis, not for long-term accommodation.

Accommodation and service platforms can feature:

- communication and management systems;
- accommodation and welfare facilities;
- helipads;
- systems allowing vessels to dock and exchange crews;
- back-up generators;
- large-scale power storage systems (batteries, etc.) and other related systems;
- small-scale or large-scale electrical power systems;
- auxiliary and anti-interference power systems;
- navigational, aviation, safety and lighting markings;
- refuelling equipment for ships and helicopters;
- drinking water tanks;
- dirty water separators;
- warehouses (for tools, fuel, spare parts);
- cranes.

Types of support structures or foundations considered for the construction of accommodation and service platforms include such options as for substations, primarily, gravity based structure or jacket foundation.

It is assumed that offshore accommodation and service platforms are identical to substations in terms of dimensions, support structure or foundation as well as methodology of installation, operation and decommissioning.

2.3 Project variants considered

2.3.1 Approach to designating project variants

The planned project was described using the same parameters for the two variants analysed in the further part of the EIA Report, i.e.:

- Applicant Proposed Variant (APV);
- Rational Alternative Variant (RAV).

With regard to these parameters, maximum possible values were assumed in each case. This assumption allows for an Environmental Impact Assessment to be carried out with a large safety margin, as the maximum individual parameters will always be considered in the assessment, even if they do not actually occur cumulatively.

The project was characterised by the following parameters specified for each variant:

- the maximum total installed capacity of the OWF – the final capacity will be derived from the optimisation from the point of view of environmental, technological and economic conditions or other factors;
- the maximum total number of wind power stations – a parameter resulting from the maximum installed capacity of the OWF and the assumed size of wind power stations; it is possible to use wind power stations of different size and power within the OWF;
- the maximum diameter of the rotor of a wind power station – the parameter defining the rotor diameter (size);
- the minimum clearance between the rotor operation area and the water surface – a parameter defining the distance between the outline of the rotor operation area and water surface level;
- the maximum height of a wind power station structure including the rotor – a parameter defining the maximum height of the wind power station structure, from the water surface to the outline of the rotor operation area;
- the maximum length of cable routes of the OWF internal wiring – a parameter defining the total length of cable routes along which the internal cables will be laid, connecting individual wind power stations with substations.

2.3.2 Project variants considered together with the justification of their selection

In accordance with the requirements of the EIA Reports, both variants subject to assessment are rational, i.e. feasible under the existing legal status (including the decision PSzW No. MFW/6/12, as amended), technical and technological conditions and with the current state of knowledge about environmental conditions.

2.3.2.1 Applicant Proposed Variant (APV)

The Applicant Proposed Variant is the variant assuming the application, to the greatest extent possible, of state-of-the-art technological solutions available on the market at the stage of the development of a construction project. It also assumes that the Baltic Power OWF will achieve the maximum total nominal power specified in the PSzW No. MFW/6/12, as amended. This variant provides for the possibility of using wind turbines of various capacities, the smallest one being 9.5 MW. Moreover, different types of foundations or support structures are allowed. The implementation of the Baltic Power OWF project with a total maximum capacity specified in the PSzW No. MFW/6/12, as amended (up to 1200 MW), assumes the installation of up to 126 wind power stations.

The Applicant Proposed Variant takes into account the continuous intense development of OWF technology in recent years, in terms of increasing the size of rotors, generators and structural elements, as well as in terms of increasing the effectiveness of the technical and technological solutions applied.

Currently, leading producers of wind power stations invest significant financial resources aimed at improving and optimising existing wind power plant solutions. In the coming years, it can be expected that several producers will start manufacturing 10 MW power stations and more (12 MW power stations will be available for production already in 2021). Thus, new models will reach market maturity and will be verified. An excellent example of this process is the work on implementing a new wind turbine, Haliade-X (by General Electric), with a capacity of 12 MW. The turbine is currently subject to tests at the port quay in Rotterdam. The entire structure is 269 m high and the rotor diameter is 220 m.

Considering the above, and assuming that the Applicant assumes the installation of wind turbines of at least 9.5 MW under this variant, any other feasible solution (with higher turbine capacity) will result in the following:

- fewer wind power stations;
- smaller total rotor operation area;
- reduction of the risk related to the number of offshore operations.

In fact, according to further analyses of the environmental impact, the APV is a more environmentally beneficial option, compared with the RAV.

2.3.2.2 Rational Alternative Variant (RAV)

The Rational Alternative Variant has been selected as a variant based on existing technologies that are currently applied and available on the market on an industrial scale. This variant assumes a wind turbine with a capacity of 5 MW. The assumed turbine capacity, with the maximum total nominal capacity of the OWF indicated in PSzW No. MFW/6/12, as amended, determines the number of wind power stations in this variant, namely 240.

Similarly to the APV, in the RAV, it is assumed that different types of wind power stations can be used, on different types of foundations or support structures.

2.3.2.3 Compilation of the technical parameters of the project variants considered

The table below (Table 2.4) presents the most important parameters of the project for both variants analysed in this EIA Report.

Table 2.4. Compilation of key parameters of the Baltic Power OWF for the Applicant Proposed Variant (APV) and the Rational Alternative Variant (RAV) [Source: own materials]

Parameter	Unit	APV	RAV
Maximum installed capacity	MW	1200	1200
Maximum number of wind power stations	-	126	240
Maximum diameter of the rotor	m	260	180
Minimum clearance between the rotor operation area and the water surface	m	20	20
Maximum height	m a.s.l.	330	250
Maximum number of additional structures	-	12	12
Maximum length of inner cable routes in the OWF	km	600	600

2.4 Description of particular phases of the project

2.4.1 General information relating to all phases of the project

Due to the location of the planned project, implemented entirely within the maritime area, all activities related, in all project phases, will be conducted in in a manner typical of maritime operations, taking into account their unique conditions and specificity. Deliveries to and from the OWF Area will be carried out with the use of various types of vessels:

- construction and installation vessels – large specialist vessels, with an advanced safety level, equipped with dynamic positioning systems (with various degrees of protection), not requiring anchoring during the works; during operation, such vessels often offer the possibility of full stabilisation in a selected position thanks to systems of supports resting on the seabed;
- transport vessels – universal or specialised vessels adapted to transporting large structures (including foundations or support structures, towers, and blades), often equipped with dynamic positioning systems;
- transport barges (platforms) – vessels used for transporting large structural elements to the site, usually without their own drive, using pushers or tugs;

- pushers and tugs – auxiliary vessels used for manoeuvring larger vessels, transport barges or for transporting large structural elements (e.g. foundations or support structures for wind power stations) from ports to the place of installation;
- service vessels − usually smaller vessels, used for transporting OWF service personnel or consumable materials, adapted for mooring to the towers of wind power stations or accompanying platforms and enabling a safe transfer of people and smaller equipment to the structural elements of OWFs.

In certain cases, especially during the OWF exploitation phase, helicopters can be used for transporting service personnel or in emergency situations.

Activities related to the transport of large-size structural elements of OWFs must be carried out from ports that meet specific requirements, i.e. in particular:

- sufficient length and bearing capacity of the quay, allowing the assembly, storage and loading of OWF structural elements;
- appropriate depth of port basins, allowing for the operation of large construction vessels.

It is assumed, that the estimated size of the area used as a space of storage and potential initial assembly of OWF structural elements should be ca. 20 ha. The quay on which works related to loading of these elements on ships are possible should be at least 300 m long and should have the appropriate bearing capacity.

At the current development stage of the Baltic Power project, the following ports of installation are considered: Gdynia, Gdańsk, Sassnitz-Mukran, Szczecin, Świnoujście, Rønne, Rostock, Aalborg, Karlskrona and Klaipeda. The nearest port with complete infrastructure used for offshore wind energy activities is Rønne in Denmark (on the island of Bornholm). The nearest Polish port that can serve as an installation port is Gdynia.

During the exploitation phase of the Baltic Power OWF it will be possible to use smaller ports, located at a shorter distance from the area of the planned project than the ports indicated above, i.e. the ports in Władysławowo, Ustka, Łeba, Hel, Darłówek as well as Kołobrzeg or Dziwnów.

In accordance with Article 24.1 of the Act of 21 March 1991 on maritime areas of the Republic of Poland and maritime administration (Journal of Laws of 2019, item 2169, as amended) a competent director of the maritime office will be able to establish, by way of issuing a regulation, safety zones around all OWF structures or around complexes of these structures located at a distance of up to 1000 m from one another, adjusted to the type and purpose of artificial islands, structures and devices or their complexes, reaching out not more than 500 m from each point of their external edge, unless a different range of the zone is permitted by generally accepted international standards or recommended by a competent international organisation. In the regulation issued, the director of the maritime office shall define the conditions for navigation within the established zones, including, in particular, restrictions regarding navigation, fishing, water sports, diving and underwater work.

The information about activities conducted during the OWF construction phase, the establishment of safety zones around OWF structures, as well as a total or partial decommissioning of the OWF will be published in official publications of the Hydrographic Office of the Polish Navy.

In each phase of the Baltic Power OWF implementation, mandatory legal requirements and good practices will be applied regarding waste and sewage treatment. During various phases of the Baltic Power OWF implementation various hazardous materials will be used. A relevant list and estimated quantities assumed are presented in the tables (Table 2.5–Table 2.7), next to the description of each phase.

All vessels involved in the project will meet the requirements and will comply with the regulations resulting from the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78), including, in particular, the procedures contained in "Shipboard Oil Pollution Emergency Plans".

Moreover, throughout the Baltic Power OWF installations, in case of the investor's inability to use dry transformers, measures will be applied to prevent the spillage of hazardous substances along with measures to eliminate the effects of a possible spillage of hazardous substances (e.g. trays capturing possible spillages of transformer oil) as well as measures to eliminate the effects of spillage of these substances (e.g. sorbents). The oil-polluted water produced during the works will be collected and separated to obtain oil-derivative concentrations below 15 b.s.l. and the oil obtained from the separation process will be stored and transferred in appropriate containers to specialised waste disposal companies.

The same will be done in the case of other waste, including other hazardous waste – they will be sorted, collected in specially marked and secured containers, transported ashore and transferred to specialised companies for utilisation.

2.4.2 Construction phase

OWF construction phase is the phase of the project requiring the mobilisation and involvement of the largest number of vessels, equipment and human resources. It is necessary to develop a complex process of supply chain of both goods and specialist services in various areas: manufacturing, transport, construction, assembly and installation. Moreover, the implementation of this phase will require precise coordination of individual activities, taking into account specific conditions resulting from the implementation of investments in a maritime area. This phase will cover four areas of activities related to:

- seabed preparation before setting foundations or support structures for individual OWFs (wind power stations, platforms); the type of actions carried out will result from the geological conditions at the sites of foundation placement and the type of foundations used;
- transport and setting of OWF foundations or support structures in the seabed;
- transport and installation of elements of wind power stations, substations as well as accommodation and service stations on the platforms;
- laying internal cables connecting individual OWF structures.

Depending on the strategy adopted for the project implementation, the above-mentioned actions may be performed sequentially or simultaneously. For example, after the preparation of a part of the seabed before setting foundations or support structures on this part of the seabed, it will be possible to conduct activities related to foundation setting.

It is assumed that the construction phase will be completed in the shortest possible time lasting between 2 and 8 years. Before beginning the OWF construction phase, it will be necessary to set up an onshore area (construction facilities and storage yards) where the initial assembly of wind power station components will be performed and where OWF construction elements will be stored. The area will be located in a port or shipyard infrastructure existing for the duration of the project, with a direct or very good access to a quay dedicated to the operations of loading and unloading of vessels involved in the construction process and subsequent maintenance of the OWF. Individual elements of the OWF will be transported by ships to the area of their foundation or installation. The arrangement of such a place within the boundaries of existing port or shipyard infrastructure will not affect their current functioning significantly.

Transfer of sediments as a result of construction works

Depending on the depth and geological conditions in the area of the Baltic Power OWF and on the type of foundations or support structures used, relevant activities will be performed to prepare the seabed before setting the foundations for OWF structural elements. Such activities may include:

- seabed levelling;
- ground replacement;
- removal or displacement of layers of seabed sediments;
- and others.

One of the important elements resulting from the works involving seabed sediments is the method of their management. It is assumed, that displaced sediments will be fully managed within the Baltic Power OWF Area. The sediment will be moved only in the closest vicinity of the works. No pollution has been found within the sediments in the Baltic Power OWF Area, therefore, no sediment moving is planned to dump sites or landfills. The highest amount of displaced sediments can occur in the case of GBS but these sediments can be used to fill and load the foundations of support structures or to shape the seabed around the foundation.

Noise emissions connected to the underwater works

For most OWFs, the construction area must be prepared using the dredging process, which generates noise and causes the lifting of suspended solids [69, 339]. As with many other activities, dredging generates underwater noise. The four basic types of dredgers are suction dredgers (CSD), trailing suction hopper dredgers (TSHD), grab dredgers (GD) and backhoe dredgers (BHD). TSHD is used on many occasions. The noise emitted by TSHD comes from various sources, mainly from the ship propulsion and the suction head of the dredger [70] (Figure 2.9).

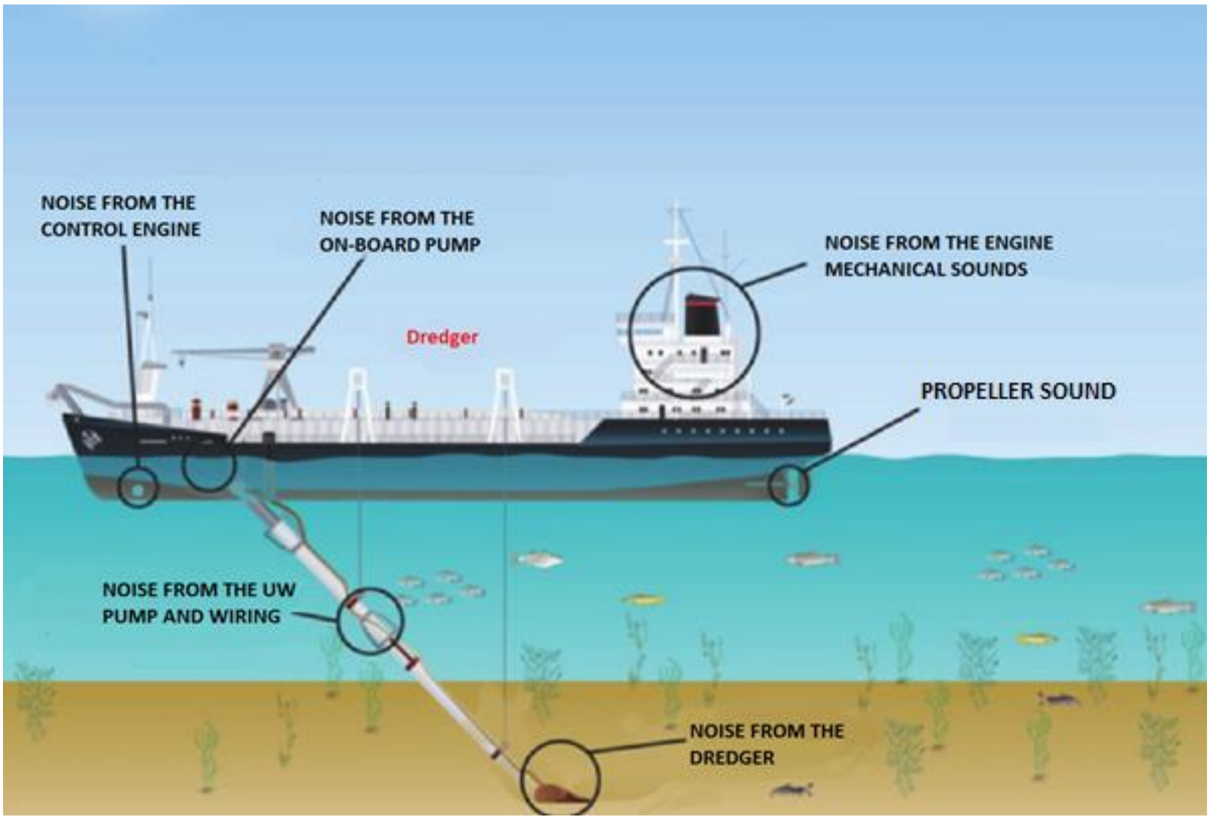


Figure 2.9. Schematic illustration of the TSHD dredger operation [Source: CEDA, 2011 [70]]

Robinson *et al.* [350] tested that TSHD emits noise at frequencies below 500 Hz. It has also been found that noise originating from a TSHD may have a frequency above 1 kHz depending on the composition of the substrate excavated during dredging. It is believed that the highest noise level is generated by the larger grains of sand and gravel when pumped through a pipe. However, even if the dredged substrate is sandy, acoustic energy is still produced which can affect porpoises and seals. Reported noise levels are 186–188 dB re 1 µPa rms at 1 m [413, 350]. These levels are much lower than in the case of a pile driver operation, but because the dredging noise is more or less continuous, and the piling noise intermittent (pulse length = 50 ms) they cannot be compared.

The underwater works using dredging systems can occur with the greatest intensity during construction and decommissioning. During the exploitation phase, such operations can only take place in case of emergency service works (e.g. the repair of buried broken cables).

Transport routes (offshore and onshore)

Maritime transportation will be of main significance and the impact of land transportation should be minimal. Land transportation will take place within existing transportation solutions. It is possible that the assembly or production of large-scale elements will take place in port or shipyard areas. Traffic in maritime transportation will take place in places where it has been small or insignificant so far. Depending on the choice of supply concept as well as supply and service ports, the transportation system will include reloading work and vessel traffic on routes such as port – OWF – port or between ports.

The number of specialist offshore operations related to the construction phase of the Baltic Power OWF is proportional to the number of facilities installed and constructed in the OWF Area, including also the length of the electricity grid installed. Therefore, the number of operations and their effects (e.g. fuel consumption, emissions related to transport) for the APV will be smaller than in the case of the RAV.

Waste

The types and quantities of waste expected to be generated during the construction phase of the Baltic Power OWF divided in accordance with the Regulation of the Minister of the Environment of 02 January 2020 on Waste Catalogue (Journal of Laws of 2020, item 10) have been presented in the table (Table 2.5). Waste is expected to be generated in connection with normal operation of various types of ships involved in this phase of the project together with waste generation during the filling of foundations or support structures with cement or sediments, joining structural elements (e.g. during the welding process), driving or drilling piles (e.g. drill cuttings), assembly of corrosion protection elements and possible abrasion of protective coatings (e.g. during piling).

Table 2.5. Compilation of estimated amounts of waste generated during the construction phase of the Baltic Power OWF, annually [Source: based on the Baltic II EIA Report [382]]

Waste code (*hazardous waste)	**Waste type**	**Estimated quantity [Mg/year]**
08 01 11*	Waste paint and varnish containing organic solvents or other hazardous substances	0.05
08 01 12	Waste paint and varnish other than those mentioned in 08 01 11	0.05
12 01 13	Welding waste	0.10
13 01 09*	Mineral hydraulic oils containing halogenated organic compounds	0.05
13 01 10*	Mineral hydraulic oils that do not contain halogenated organic compounds	0.05
13 01 11*	Synthetic hydraulic oils	0.05
13 02 04*	Mineral engine, gear and lubricating oils containing halogenated organic compounds	0.05
13 02 05*	Mineral engine, gear and lubricating oils that do not contain halogenated organic compounds	0.05
13 02 06*	Synthetic engine, gear and lubricating oils	0.05
13 02 07*	Engine, gear and lubricating oils that are easily biodegradable	0.05
13 02 08*	Other engine, gear and lubricating oils	0.05
13 03 01*	Oils and liquids used as electroisolators and heat carriers containing PCBs	0.20
13 04 03*	Bilge oils from sea ships	0.10
13 05 02*	Sludge from dewatering oil in separators	0.50
13 05 06*	Oil from dewatering oil in separators	0.50
13 05 07*	Oily water from dewatering oil in separators	0.50
13 07 01*	Furnace oil and diesel oil	0.05
13 07 02*	Petrol	0.05
13 08 80	Oily solid waste from ships	0.10
14 06 01*	Freons, HCFC, HFC	0.05
14 06 02*	Other halogenated organic solvents and solvent mixtures	0.05
14 06 03*	Other solvents and solvent mixtures	0.05
15 01 01	Paper and cardboard packaging	2.00
15 01 02	Plastic packaging	2.00

Waste code (*hazardous waste)	Waste type	Estimated quantity [Mg/year]
15 01 03	Wooden packaging	2.00
15 01 04	Metal packaging	2.00
15 01 05	Multi-material packaging	2.00
15 01 06	Mixed packaging waste	2.00
15 01 07	Glass packaging	0.10
15 01 09	Textile packaging	0.10
15 02 02*	absorbents, filter materials (including oil filters not otherwise specified), wiping cloths (e.g. rags, wipes), protective clothing contaminated by hazardous substances (e.g. PCB)	1.00
15 02 03*	Sorbents, filter materials, wiping cloths (e.g. rags, dishcloths) and protective clothing other than those listed in 15 02 02	1.00
16 06 01*	Lead batteries and accumulators	0.10
16 06 02*	Nickel-cadmium batteries and accumulators	0.10
16 06 03*	Batteries containing mercury	0.01
16 06 04	Alkaline batteries (excluding 16 06 03)	0.01
16 06 05	Other batteries and accumulators	0.01
16 81 01*	Wastes of hazardous properties	1.00
16 81 02	Waste other than those listed in 16 81 01	1.00
17 01 01	Concrete waste and debris from demolition and renovation	50.00
17 01 03	Tiles and ceramics	10.00
17 01 82	Other not mentioned waste	50.00
17 02 01	Wood	2.00
17 02 02	Glass	0.10
17 02 03	Plastics	5.00
17 04 01	Copper, bronze, brass	0.05
17 04 02	Aluminium	0.05
17 04 04	Zinc	0.05
17 04 05	Iron and steel	1.00
17 04 07	Metal alloys	0.05
17 04 11	Cables other than those listed in 17 04 10	5.00
17 09 03*	Other waste from construction, renovation and dismantling (including mixed waste) containing dangerous substances	20.00
17 09 04	Mixed construction, renovation and dismantling waste other than those listed in 17 09 01, 17 09 02 and 17 09 03	20.00
19 08 05	Stabilised municipal sewage sludge	1.00
20 01 01	Paper and cardboard	1.00
20 01 02	Glass	1.00
20 01 08	Biodegradable kitchen waste	1.00
20 01 10	Clothing	1.00
20 01 21*	Fluorescent lamps and other waste containing mercury	0.05

Waste code (*hazardous waste)	Waste type	Estimated quantity [Mg/year]
20 01 23*	Devices containing freons	0.05
20 01 29*	Detergents containing dangerous substances	0.05
20 01 30	Detergents other than those listed in 20 01 29	0.05
20 01 33*	Batteries and accumulators, including batteries and accumulators specified in 16 06 01, 16 06 02 or 16 06 03, and unsorted batteries and accumulators containing these batteries	0.05
20 01 34	Batteries and accumulators other than those listed in 20 01 33	0.05
20 01 35*	Electrical and electronic equipment waste other than those listed in 20 01 21, 20 01 23 containing hazardous components (1)	0.05
20 01 36	Electrical and electronic equipment waste other than those listed in 20 01 21, 20 01 23 and 20 01 35	0.05
20 03 01	Unsorted (mixed) municipal waste	20.00

2.4.3 Construction and exploitation phase

The OWF construction concept assumes the possibility of simultaneous OWF construction and exploitation. In terms of impact assessment, this phenomenon will be the sum of the simultaneous impact of the OWF construction in one place and exploitation elsewhere. Due to the different location and different technical requirements, conflicts and collisions should not be expected, provided that the exploitation and further development of the OWF will be covered by the coordinated ship traffic plan in the OWF Area.

2.4.4 Exploitation phase

Unlike the construction phase, this phase will be characterised by reduced vessel traffic. In general, vessel traffic for this phase will be recorded with an increased share of small and medium vessels associated with the OWF exploitation and maintenance. Three variants of operation are possible:

- the use of offshore accommodation and service stations – the movement of small vessels within the farm will take place between the station and individual wind power stations. To secure the functioning of the accommodation and service station, cyclical supply transport and periodic exchange of the station crew and service personnel will be necessary. The estimated number of trips will minimally increase the intensity of navigation for the main navigation routes and will only slightly increase the intensity of navigation in the service port;
- the use of medium sized vessels – service bases that will perform periodic service duty in the OWF Area and make cyclical trips to service ports to replenish the supplies and exchange service personnel or crew. Changes in the intensity of navigation will occur in the same way as in the case above;
- the use of small vessels travelling between the service port(s) and the OWF Area as well as fast response units in the daily work cycle. The estimated number of trips will significantly increase the intensity of navigation on navigation routes and in ports.

The number of offshore operations related to the exploitation phase of the Baltic Power OWF is proportional to the number of facilities installed and constructed in the OWF Area, including also the length of the electricity grid installed. Therefore, the number of operations and their effects (e.g. fuel consumption, emissions related to transport) for the APV will be smaller than for the RAV.

Electromagnetic field (EMF)

The OWF exploitation will be a long-term project. Offshore wind power stations will be connected by electricity grid and telecommunication networks with offshore substations. It is assumed that the total length of cable routes along which the cables will be laid in the OWF Area will not exceed 600 km. Cables buried in the seabed are optimised to emit a residual electric field. The possible magnetic component of the EMF is minimised by the conduct of the individual wires in the greatest proximity to each other (for individual phases for alternating current or the flow directions of direct current). In the case of the DC cables, the range of EMF influence is the smaller the closer the individual conductors of the line are run (there are practically no interactions in the composite cable). In the case of alternating current, the use of a composite cable reduces the magnetic field, but it may remain at the level generating electric field in the seawater [312]. The remedy for this is the burial of the cable in the sediment, which does not reduce the effects of EMF by itself but separating the cables from seawater reduces the impact considerably.

Heat emission through power cables

Electric current, flowing through a cable, causes it to heat up, as a result of power losses on the resistance, in accordance with Joule's law. As the temperature of the cable increases above the ambient temperature, the transfer of heat commences from the cable to the surrounding environment. An accurate quantification of the emitted heat is difficult because of the following phenomena: heat radiation, conduction and convection, subject to different physical laws [391]. The heating of sediments may lead to a change in the taxonomic composition of the benthos living on and in the seabed in the immediate vicinity of the cables [285]. According to the OSPAR's guide on the best environmental practices in the laying and use of subsea cables [312] the burial of the cable at a depth of 1 to 3 m under the seabed is sufficient to allow within 0.2 m below the seabed surface the rise of the sediment temperature associated with heat emission through the power cables under load to be not greater than the recommended 2°C. The minimum burial depth should be determined on the basis of the type of sediments (their thermal conductivity) and the type of electricity grid (size and type of loads, thermal characteristics).

Waste

The expected types and quantities of waste generated during the exploitation phase of the Baltic Power OWF divided in accordance with the Regulation of the Minister of the Environment of 02 January 2020 on Waste Catalogue (Journal of Laws of 2020, item 10) have been presented in the table (Table 2.6). The amounts of waste shown refer to a single offshore wind power station or offshore substation. Therefore, it should be assumed that the amount of solid waste and wastewater will be significantly higher in the case of the RAV than in the APV.

The main factors causing the generation of waste and wastewater during the Baltic Power OWF exploitation phase is the operation of ships and carrying out of repairs.

Table 2.6. Compilation of waste generated during the exploitation phase of the Baltic Power OWF, annually [Source: based on the Baltic II EIA Report [382]]

Waste code (*hazardous waste)	Waste type	Estimated quantity [Mg/year]
08 01 11*	Waste paints and varnishes containing organic solvents or other dangerous substances	0.50
08 01 12	Waste paints and varnishes other than those listed in 08 01 11	0.50

Waste code (*hazardous waste)	**Waste type**	**Estimated quantity [Mg/year]**
12 01 13	Welding waste	0.10
13 01 09*	Mineral hydraulic oils containing halogenated organic compounds	0.03
13 01 10*	Mineral hydraulic oils that do not contain halogenated organic compounds	0.03
13 01 11*	Synthetic hydraulic oils	0.03
13 01 12*	Hydraulic oils that are easily biodegradable	0.03
13 01 13*	Other hydraulic oils	0.03
13 02 04*	Mineral engine, gear and lubricating oils containing halogenated organic compounds	0.03
13 02 05*	Mineral engine, gear and lubricating oils that do not contain halogenated organic compounds	0.03
13 02 06*	Synthetic engine, gear and lubricating oils	0.03
13 02 07*	Engine, gear and lubricating oils that are easily biodegradable	0.03
13 02 08*	Other engine, gear and lubricating oils	0.03
13 03 01*	Oils and liquids used as electroisolators and heat carriers containing PCBs	1.00
13 04 03*	Bilge oils from sea ships	0.10
13 05 02*	Sludge from dewatering oil in separators	0.50
13 05 06*	Oil from dewatering oil in separators	0.50
13 05 07*	Oily water from dewatering oil in separators	0.50
13 07 01*	Furnace oil and diesel oil	0.10
13 07 02*	Petrol	0.05
13 08 80	Oily solid waste from ships	0.10
14 06 01*	Freons, HCFC, HFC	0.05
14 06 02*	Other halogenated organic solvents and solvent mixtures	0.05
14 06 03*	Other solvents and solvent mixtures	0.05
15 01 01	Paper and cardboard packaging	0.10
15 01 02	Plastic packaging	0.10
15 01 03	Wooden packaging	0.10
15 01 04	Metal packaging	0.10
15 01 05	Multi-material packaging	0.10
15 01 06	Mixed packaging waste	0.10
15 01 07	Glass packaging	0.10
15 01 09	Textile packaging	0.10
15 02 02*	Sorbents, filter materials (including oil filters not included in other groups), wiping cloths (e.g. rags, dishcloths) and protective clothing contaminated with dangerous substances (e.g. PCBs)	0.30
15 02 03*	Sorbents, filter materials, wiping cloths (e.g. rags, dishcloths) and protective clothing other than those listed in 15 02 02	0.30
16 06 01*	Lead batteries and accumulators	0.10
16 06 02*	Nickel-cadmium batteries and accumulators	0.10
16 06 03*	Batteries containing mercury	0.01
16 06 04	Alkaline batteries (excluding 16 06 03)	0.01
16 06 05	Other batteries and accumulators	0.01
16 81 01*	Wastes of hazardous properties	0.30

Waste code (*hazardous waste)	Waste type	Estimated quantity [Mg/year]
16 81 02	Waste other than those listed in 16 81 01	0.30
17 01 01	Concrete waste and debris from demolition and renovation	5.00
17 01 03	Wastes of other ceramic materials and equipment items	1.00
17 01 82	Waste not otherwise specified	5.00
17 02 01	Wood	0.20
17 02 02	Glass	0.10
17 02 03	Plastics	0.50
17 04 01	Copper, bronze, brass	0.05
17 04 02	Aluminium	0.05
17 04 04	Zinc	0.05
17 04 05	Iron and steel	1.00
17 04 07	Metal alloys	0.05
17 04 11	Cables other than those listed in 17 04 10	5.00
17 09 03*	Other waste from construction, renovation and dismantling (including mixed waste) containing dangerous substances	2.00
17 09 04	Mixed construction, renovation and dismantling waste other than those listed in 17 09 01, 17 09 02 and 17 09 03	2.00
19 08 05	Stabilised municipal sewage sludge	3.00
20 01 01	Paper and cardboard	2.00
20 01 02	Glass	2.00
20 01 08	Biodegradable kitchen waste	2.00
20 01 10	Clothing	2.00
20 01 21*	Fluorescent lamps and other waste containing mercury	0.10
20 01 23*	Devices containing freons	0.10
20 01 29*	Detergents containing dangerous substances	0.10
20 01 30	Detergents other than those listed in 20 01 29	0.10
20 01 33*	Batteries and accumulators, including batteries and accumulators specified in 16 06 01, 16 06 02 or 16 06 03, and unsorted batteries and accumulators containing these batteries	0.10
20 01 34	Batteries and accumulators other than those listed in 20 01 33	0.10
20 01 35*	Electrical and electronic equipment waste other than those listed in 20 01 21, 20 01 23 containing hazardous components (1)	0.10
20 01 36	Electrical and electronic equipment waste other than those listed in 20 01 21, 20 01 23 and 20 01 35	0.10
20 03 01	Unsorted (mixed) municipal waste	30.00

2.4.5 Decommissioning phase

In technical terms, the decommissioning phase is a reversal of the OWF construction phase. In the reverse order of the construction phase, individual OWF components will be removed and transported to disposal sites.

The number of offshore operations related to the decommissioning phase of the Baltic Power OWF is proportional to the number of facilities installed and constructed in the OWF Area, including also the length of the electricity grid installed. Therefore, the number of operations and their effects (e.g. fuel consumption, emissions related to transport) will be smaller for the APV than in the case of the RAV.

Waste

The types and quantities of waste expected to be generated during the decommissioning phase of the Baltic Power OWF divided in accordance with the Regulation of the Minister of the Environment of 02 January 2020 on Waste Catalogue (Journal of Laws of 2020, item 10) have been presented in the table (Table 2.7). The amounts of waste presented concern a single OWF or an offshore substation or 1 km of cable. A higher value, resulting from the comparison for these two types of structures, has been assumed in the comparison. Therefore, it should be assumed that the amount of solid waste and wastewater will be significantly higher in the case of the RAV than in the APV.

It is expected that decommissioning of the structures in the Baltic Power OWF Area will take place to the level of the seabed (embedded piles will be left in the seabed, because they do not cause environmental impact, whereas their removal may cause environmental impact – e.g. when applying disposal methods employing explosives). In the case of the decommissioning of the Baltic Power OWF, the generation of waste is mainly related to the physical removal of the worn-out components of the Baltic Power OWF and the operation of ships used during the decommissioning.

Table 2.7. Compilation of waste generated during the decommissioning phase of the Baltic Power OWF, for a single structure [Source: based on the Baltic II EIA Report [382]]

Waste code (*hazardous waste)	Waste type	Estimated quantity [Mg/structure]
13 01 09*	Mineral hydraulic oils containing halogenated organic compounds	0.05
13 01 10*	Mineral hydraulic oils that do not contain halogenated organic compounds	0.05
13 01 11*	Synthetic hydraulic oils	0.05
13 01 12*	Hydraulic oils that are easily biodegradable	0.05
13 01 13*	Other hydraulic oils	0.05
13 02 05*	Mineral engine, gear and lubricating oils that do not contain halogenated organic compounds	0.01
13 02 05*	Mineral engine, gear and lubricating oils that do not contain halogenated organic compounds	0.01
13 02 06*	Synthetic engine, gear and lubricating oils	0.01
13 02 07*	Engine, gear and lubricating oils that are easily biodegradable	0.01
13 02 08*	Other engine, gear and lubricating oils	0.01
13 03 01*	Oils and liquids used as electroisolators and heat carriers containing PCBs	82.5
13 04 03*	Bilge oils from sea ships	0.1
13 07 01*	Furnace oil and diesel oil	0.05
13 07 02*	Petrol	0.05
13 08 80	Oily solid waste from ships	0.1
14 06 01*	Freons, HCFC, HFC	0.1
14 06 02*	Other halogenated organic solvents and solvent mixtures	0.1
14 06 03*	Other solvents and solvent mixtures	0.1
15 01 01	Paper and cardboard packaging	0.1
15 01 02	Plastic packaging	0.1
15 01 03	Wooden packaging	0.1
15 01 04	Metal packaging	0.1
15 01 05	Multi-material packaging	0.1
15 01 06	Mixed packaging waste	0.1

Waste code (*hazardous waste)	**Waste type**	**Estimated quantity [Mg/structure]**
15 01 07	Glass packaging	0.1
15 01 09	Textile packaging	0.1
15 02 02*	Sorbents, filter materials (including oil filters not included in other groups), wiping cloths (e.g. rags, dishcloths) and protective clothing contaminated with dangerous substances (e.g. PCBs)	1
15 02 03*	Sorbents, filter materials, wiping cloths (e.g. rags, dishcloths) and protective clothing other than those listed in 15 02 02	1
16 06 01*	Lead batteries and accumulators	0.1
16 06 02*	Nickel-cadmium batteries and accumulators	0.1
16 06 03*	Batteries containing mercury	0.01
16 06 04	Alkaline batteries (excluding 16 06 03)	0.01
16 06 05	Other batteries and accumulators	0.01
16 81 01*	Wastes of hazardous properties	1
16 81 02	Waste other than those listed in 16 81 01	1
17 01 01	Concrete waste and debris from demolition and renovation	7000
17 01 03	Wastes of other ceramic materials and equipment items	50
17 01 07	Mixed waste from concrete, brick rubble, ceramic materials and elements of equipment other than those listed in 17 01 06	50
17 01 82	Other waste, not otherwise specified	50
17 02 01	Wood	0.1
17 02 02	Glass	2
17 02 03	Plastics	1 000
17 04 01	Copper, bronze, brass	1
17 04 02	Aluminium	1
17 04 04	Zinc	1
17 04 05	Iron and steel	4000
17 04 07	Metal alloys	1
17 04 11	Cables other than those listed in 17 04 10	71
17 09 03*	Other waste from construction, renovation and dismantling (including mixed waste) containing dangerous substances	50
17 09 04	Mixed construction, renovation and dismantling waste other than those listed in 17 09 01, 17 09 02 and 17 09 03	50
19 08 05	Stabilised municipal sewage sludge	1
20 01 01	Paper and cardboard	1
20 01 02	Glass	1
20 01 08	Biodegradable kitchen waste	1
20 01 10	Clothing	1
20 01 21*	Fluorescent lamps and other waste containing mercury	0.05
20 01 23*	Devices containing freons	0.05
20 01 29*	Detergents containing dangerous substances	0.05
20 01 30	Detergents other than those listed in 20 01 29	0.05
20 01 33*	Batteries and accumulators, including batteries and accumulators specified in 16 06 01, 16 06 02 or 16 06 03, and unsorted batteries and accumulators containing these batteries	0.05

Waste code (*hazardous waste)	Waste type	Estimated quantity [Mg/structure]
20 01 34	Batteries and accumulators other than those listed in 20 01 33	0.05
20 01 35*	Electrical and electronic equipment waste other than those listed in 20 01 21, 20 01 23 containing hazardous components (1)	0.05
20 01 36	Electrical and electronic equipment waste other than those listed in 20 01 21, 20 01 23 and 20 01 35	0.05
20 03 01	Unsorted (mixed) municipal waste	20

2.4.6 Information on energy demand and consumption

The most important factor shaping the energy demand and consumption is the choice of the structure types erected in the OWF Area and the organisation of construction works, and later the selection of one of the OWF operation methods presented in subsection 2.4.4. The energy needed and consumed for the construction of the OWF is almost 100% fuel used for transportation, transshipment and installation of components of wind power stations and other OWF facilities.

In contrast to commercial shipping, specialist vessels adapted to work in the construction and maintenance of offshore industrial structures have a different operation profile. This is primarily related to the need to perform complex marine operations (transshipments, working in dynamic positioning mode), which are not related to the distance travelled, but determined by the number of working hours. Therefore, the estimation of the planned fuel consumption depends on a very large number of variable factors and is virtually always subject to a significant error.

Average fuel consumption values for different types of vessels have been presented in the table (Table 2.8).

Table 2.8. Average fuel consumption for different types of vessels [Source: own materials based on Borkowski [53]]

Vessel size	Purpose	Average fuel consumption (diesel) [kg·h^{-1}]	Nominal daily working time [h]
Small vessels	Small supplies, personnel transport, one-day service, emergency operations – for each phase	50–200	8–10
Medium vessels	Supplies, support for construction works, towing operations, multi-day stationary service – for each phase	500–2000	12–18
Large vessels	Supplies, storage, construction work – mainly for the construction and demolition phase	2500–5000	12–24

The number of offshore operations related to the construction, exploitation and decommissioning phase of the Baltic Power OWF is proportional to the number of facilities installed and constructed in the OWF Area, also including the length of the electricity grid installed. Therefore, fuel quantities and transport related emissions will be lower for the APV than for the RAV.

2.5 Risk of major accidents or natural and construction disasters

2.5.1 Types of breakdowns resulting in environmental contamination

The project related to the construction, exploitation and decommissioning of an OWF is an undertaking involving several decades of complex activities carried out on land and at sea.

The project which is the subject of this report is not a place of storage of substances determining the project classification as a plant with an increased or high risk of a serious industrial accident pursuant to the Regulation of the Minister of Development of 29 January 2016 on the types and quantities of hazardous substances present in the industrial plants, which determine the plant classification as a plant with an increased or high risk of a serious industrial accident (Journal of Laws of 2016, item 138).

The production of all elements for the OWF construction and exploitation takes place on land. Construction, installation, service, renovation and subsequent demolition work are carried out at sea. All these activities depend on vessels: transportation, service and construction.

Ports and ships are of key importance during the implementation of the project. Large-scale components of wind power stations, foundations or structures and towers, accommodation and service platforms and measurement and survey platforms as well as power substations are manufactured in ports or in their immediate vicinity. The technologies and production processes related to their production do not create a risk of emergency situations. Possible emergencies will not cause significant emissions of pollutants threatening the environment. Also during the decommissioning or disposal of disassembled elements of wind power stations which take place in port or industrial areas, no events causing environmental hazard are expected.

The main threats that may occur during an OWF construction and decommissioning are the spillages of oil derivative substances, mainly diesel, hydraulic, transformer and lubricating oils. To a lesser extent, the marine environment may incidentally be endangered with materials containing hazardous substances, if they were used. During the operation phase, the main cause of marine pollution can be oil spills. Both within the open sea waters (e.g. the OWF Area) and near the coast, they can constitute a problem with long-lasting effects on fauna, flora, fishery and beaches affected by the contamination. In order to counteract this threat, OWF installations will be equipped with protective measures against spillage of hazardous substances, as described in the subsection below 2.4.1.

The size of oil contamination can be classified in the following way:

- **I degree (small spillage, up to 20 m^3)** – small leakages of oil derivative substances that do not require the intervention of external forces and resources and are possible to be removed with own resources. These spills have a local character, their removal does not present particular technical difficulties and they do not pose a great threat to the marine environment;
- **II degree (medium-sized spillage, up to 50 m^3)** – spills of oil derivative substances, the scale of which requires a coordinated counteraction within the maritime area under the authority of the Director of the Maritime Office who decides on the scale of the counteraction required;
- **III degree (catastrophic spillage, above 50 m^3)** – oil derivatives spill that is extremely dangerous to the environment, the neutralisation of which involves forces and resources subordinate to more than one Director of the Maritime Office.

2.5.2 Accident description with a potential impact assessment

2.5.2.1 Oil derivatives leak (during the normal operation of vessels)

Various oil derivative substances (lubricating and diesel oils, petrol) leaks may occur during normal vessel operation. It should be assumed that these will be small (I degree) spills.

From an environmental point of view, the places most vulnerable to any spillages are: the Słupsk Bank and the coastal area between approximately the towns of Ustka in the west and Dębki in the east. Taking into account the prevailing western wind and the coastal currents, the endangered area is the coast with tourist destinations (Jarosławiec, Rowy) and small ports from Ustka and Łeba in the west to the town and port of Władysławowo.

The areas particularly vulnerable to the potential pollution are the conservation areas including the areas belonging to the NATURA 2000 network of protected areas [346].

It should be emphasized that the key issue here is not so much the size of the spillage as the place where it has occurred. There are known cases of high bird mortality due to small oil spills into the sea. Extensive oil spills drifting away from the coasts, on waters with very low numbers of birds do not cause as much losses in populations as smaller spills in areas of high concentration of seabirds [280]. In the planned Baltic Power OWF Area, bird densities were much lower than in the other areas of great significance for seabirds. It should be underlined, however, that in the case of I degree spills and with the proper management of the ship traffic, the situation in which an uncontrolled dispersal of oil derivative substances reaches important natural areas is unlikely.

The determination of the actual extent of spillage will be technically possible only during the event, on the basis of the current meteorological data and the data on the type and potential quantity of the contaminant. Therefore, at the report stage, it is not possible to make a more detailed assessment of the impact on marine organisms that are the most exposed to the effects of oil spills.

The number of potential leaks is proportional to the number of vessels used to carry out the investment implementation, its exploitation or decommissioning.

Oil derivatives spillage (during an emergency)

During the construction, exploitation and decommissioning phase of the Baltic Power OWF a spillage of oil derivative substances may occur, the consequence of which will be the water column and sediment contamination. A leak may occur as a result of a breakdown or collision of vessels, their collision with OWF structures, their sinking or grounding, as well as during seepage and operational leaks from vessels, leakage from oil systems of a wind power stations, leakage from transformers at substations or oil spills related to inspections and repairs of OWF elements. In the worst-case scenario, during the construction or decommissioning stage, II degree spills (spills of medium size) will occur. It has been calculated that the probability of serious accidents is very small, ranging from 10^{-5} (practically impossible – 1 in 100 000 years) to 10^{-2} (rare – 1 in 100 years).

Assuming the worst case scenario and the release of 200 m^3 of diesel fuel into the marine environment, as well as taking into account its type, the behaviour in seawater, the time of oil dispersion and drift, it is estimated that the range of pollution will not exceed 5 to 20 km from the Baltic Power OWF [346]. The specificity of this type of oil means it is neither a particularly dangerous nor onerous pollutant.

The release of chemical substances and waste

During the construction of a wind farm, aboard vessels and in the infrastructure situated on land (in the port supporting the implementation of the investments) and on the project site, the waste generated will be directly related to the process of construction. These can include, among others, damaged parts of the OWF elements, cement, grout, mortar, adhesives used to connect elements of the power stations and other chemical substances used during the construction. These can be accidentally released into the sea.

Loose cement is packed in bags of about 1 m^3. It has been assumed that during transshipment about 5 m^3 of the product can sink. Grout, mortar and other sealants often contain hazardous substances. For instance, epoxy (two-component) sealants contain in various proportions: epoxy resin, alkyl glycol ethers, and polyaminoamides. Due to their high density (ca. 1.3 $g \cdot cm^{-1}$), after release into water, these substances sink and deposit on the seabed. They are considered a serious threat because they cannot be easily removed from the seabed and are toxic to marine organisms.

The possibility of releasing waste or chemicals into the water is proportional to the activity associated with the use of chemicals.

2.5.3 Other kinds of releases

2.5.3.1 Release of municipal waste or domestic sewage

During the construction of a wind farm, aboard vessels and in the infrastructure situated on land (in the port supporting the implementation of the investment) waste, mostly municipal and other, not directly related to the construction process, as well as domestic sewage will be generated. Waste and wastewater can be accidentally released into the sea while being transferred from the ship by another vessel and in the case of a breakdown, causing local increase in concentration of nutrients and deterioration of the quality of water and sediments.

It is estimated that the possible occurrence of the above releases will not affect the structure and functioning of marine organisms in the area of the project, nor will it cause their mortality.

2.5.3.2 Contamination of water and seabed sediments with antifouling agents

In order to protect ship hulls against fouling, biocides, the composition of which may include for example copper, mercury and tributyltin compounds (TBT), are used. These substances can transfer into water and eventually be retained in the sediments. It should be assumed that the emission of these compounds will be slight. Out of these substances, the most harmful (toxic) to aquatic organisms are organotin compounds. Currently, the usage of tributyltin (TBT) (the most harmful substance) in antifouling paints is prohibited. However, the presence of these compounds cannot be excluded in the protective coatings of older vessels. This impact can be limited by introducing the control of the type of protective coatings on vessels employed in operations at the OWF Area.

It is estimated that the possible occurrence of the above events will not affect the structure and functioning of marine organisms in the area of the project, nor will it increase their mortality.

2.5.3.3 Release of contaminants from anthropogenic objects on the seabed

It is impossible to exclude completely the possibility of the release of contaminants from anthropogenic objects lying on the seabed. During geophysical surveys, in 2019, the Baltic Power OWF Area was systematically checked for the presence of objects of anthropogenic origin, including packaging and containers which can contain hazardous chemicals. Such objects may come, for example, from insufficiently secured cargoes of ships passing through the Baltic Power OWF Area. No such objects were found on the seabed in the OWF Area. The possibility of such objects being buried in the seabed and therefore, not having been discovered during the geophysical surveys has not been excluded. During the geophysical surveys, magnetometric review surveys were carried out, which were to reveal only larger ferromagnetic objects. As a result of these surveys, a torpedo was identified in the Baltic Power OWF Development Area as well as an object that is probably a naval mine. Thus, it cannot be ruled out that during the preparatory work for the construction process, including, in particular, the survey of seabed cleanliness in terms of the occurrence of unexploded ordnance and chemical weapons, new anthropogenic objects (for example small barrels or unexploded ordnance) may be discovered. In order to determine the way of dealing with such finds, the Applicant will prepare a plan for handling dangerous objects, both from the point of view of operational work at sea (for example, rules for conducting works in the vicinity of potentially hazardous objects) and from the point of view of possible removal or avoidance of such objects. The basic assumption of the plan for dealing with dangerous objects is to avoid threats to human life and health and to avoid the spread of contaminants from such objects.

2.5.4 Environmental threats

2.5.4.1 Construction phase

Based on the data obtained from other OWF projects and similar undertakings as well as on the authors' knowledge and experience, the following potential environmental threats, which may become a source of negative impact of OWFs on the environment, have been identified for the construction phase:

- oil derivatives spillage as a result of collision of ships or helicopters, construction accident or catastrophe (during normal operation or an emergency situation);
- accidental release of municipal waste or domestic sewage;
- accidental release of building materials or chemical agents;
- contamination of water and seabed sediments with antifouling agents.

It should be noted that as a direct result of emergency situations and incidents, the abiotic environment, especially seawater and, to a lesser extent, seabed sediments can become contaminated. On the other hand, these events can also indirectly affect living organisms, those inhabiting or otherwise using the seabed, water column and the surface of the sea. The contamination of water or seabed sediments with municipal waste or domestic sewage is a direct negative impact, temporary or short-term, reversible and of local range. The scale of the impact is negligible.

The collision of ships and helicopters and the resulting release of dangerous substances into the environment (especially oil derivatives) is a factor which can cause increased mortality and diseases of marine organisms. The likelihood of such events can be considered as small. In addition, the implementation of a proper plan of action in case of collisions and spills aims to limit the impact of such events on marine organisms.

The main threat to the Natura 2000 sites during the construction phase is the release of hazardous substances (especially oil derivatives) into the environment as a result of collisions of ships and helicopters. This factor may cause increased mortality and diseases of marine organisms, including those which are the subject of protection in these areas. The likelihood of such events can be considered as small. The implementation of a collision and leakage management plan for the duration of the project is aimed at minimising the impact of such events on marine organisms, in accordance with the applicable laws. It can be assumed that this factor will not affect the protected areas significantly.

2.5.4.2 Exploitation phase

During the exploitation of the farm, threats to the environment may occur, especially the contamination of the water column and seabed sediments by:

- oil derivatives;
- antifouling agents;
- accidentally released municipal waste and domestic sewage;
- accidentally released chemical agents and waste from the OWF operation.

Waste and sewage may be generated by people on ships and during operation as well as during maintenance of towers and transmission infrastructure.

The collision of ships and helicopters and the resulting release of dangerous substances into the environment (especially oil derivatives) is a factor which can cause increased mortality and diseases of marine organisms. The likelihood of such events can be considered as small. The implementation of a proper plan of action in case of collisions and spills aims to limit the impact of such events on marine organisms.

The impacts caused by the occurrence of emergency situations during the exploitation phase are identical as those that may occur during the OWF construction phase. Only the aspect regarding the accidental release of chemicals and waste is slightly different. During the farm exploitation, the maintenance of its facilities will be carried out. An accidental release of small quantities of waste or operating fluids into the sea cannot be excluded. It is estimated that the possible occurrence of the above unexpected and random incidents will not affect the structure and functioning of marine organisms in the area of the project, nor will it cause their mortality.

During the OWF operation, harmful chemical substances may leak into the environment as a result of collisions and breakdowns of vessels and helicopters involved in the project service, such as mainly fuels, motor oils or hydraulic fluids. Their impact on marine organisms can be an important pathogenic factor and result in increased mortality. However, the likelihood of such events can be considered as small. The implementation of a proper plan of action in case of collisions and spills aims to limit the impact of such events. The threat from this event can be considered as irrelevant.

The main threat to the Natura 2000 sites during the exploitation phase is the release of hazardous substances (especially oil derivatives) into the environment as a result of collisions of ships and helicopters. This factor may cause increased mortality and diseases of marine organisms, including the subject of protection in these areas. The likelihood of such events can be considered as small. The implementation of a proper plan of action in case of collisions and spills aims to limit the impact of such events on marine organisms. It can be assumed that this factor will not affect the protected areas significantly.

2.5.4.3 Construction and exploitation phase

The collision of ships and helicopters and the resulting release of hazardous substances into the environment (especially oil derivatives) is a factor which can cause increased mortality and diseases of marine organisms. The likelihood of such events has been considered small in the case of separate implementation of works related to the construction and exploitation phase. However, the simultaneous presence of vessels engaged in construction and service works increases the risk of collisions and the negative impacts associated with them. Therefore, the original significance of the impact (ranging from insignificant to negligible) may increase to moderate; however, this will not necessitate the application of mitigation measures.

2.5.4.4 Decommissioning phase

During the decommissioning of the OWF, there may also be impacts resulting from the occurrence of emergency situations and other environmental hazards, in particular the contamination of the water column and seabed sediments with:

- accidentally released municipal waste and domestic sewage;
- oil-derivatives;
- antifouling agents.

The risk of sewage release from the ship into the water exists at the time of the collection of sewage from a ship by another vessel and in the event of a breakdown. It may cause local increase of nutrient concentration and the deterioration of the water quality. The contaminants should rapidly dissipate, which will stop them from contributing to a permanent environment deterioration in the project area.

The impacts related to environmental threats in the decommissioning phase are identical to the described above impacts for the OWF construction phase.

During the OWF decommissioning, as a result of collisions and breakdowns of vessels and helicopters involved in the project service, harmful chemical substances, mainly fuels, motor oils or hydraulic fluids may leak into the environment. Their impact on marine organisms can be an important pathogenic factor and result in increased mortality. However, the likelihood of such events can be considered as small. The implementation of a proper plan of action in case of collisions and spills aims to limit the impact of such events. The threat from this event can be considered as irrelevant.

2.5.5 Breakdown prevention

The prevention of breakdowns constitutes the whole range of activities related to the protection of human life and health, the natural environment and property, as well as the reputation of all participants in the processes related to the construction, exploitation and decommissioning of the OWF. These activities include, among others:

- development of plans for the safe construction, exploitation and decommissioning of the OWF in accordance with the applicable legal regulations for the duration of the project implementation;
- developing rescue plans and training of crews and personnel, including the principles of updating and verification by conducting regular exercises, in particular, determining the procedures for the use of own vessels and external vessels, including helicopters;
- developing a plan for counteracting threats and pollution arising during the construction, exploitation and decommissioning of the OWF;
- selecting suppliers as well as certified parts and components of the OWF;
- designating protection zones;
- accurate marking of the OWF Area, its facilities and vessels moving within the area;
- planning offshore operations;
- applying the standards and guidelines of the International Maritime Organization (IMO), recognised classification societies and maritime administration recommendations;
- developing plans of safe navigation within the OWF Area and safe passages to ports;
- providing adequate navigational support in the form of maps and navigational warnings;
- providing direct or indirect navigational supervision using a surveillance vessel or remote radar surveillance and Automatic Identification System (AIS);
- continuous monitoring of vessel traffic within the OWF, direct or remote throughout the entire period of the construction, exploitation and decommissioning of the OWF;
- establishment of a coordination centre supervising the construction, exploitation and decommissioning of the OWF;
- maintaining regular communication lines between the OWF coordination centre and the coordinator of works at sea and other coordination centres (Maritime Rescue Coordination Centre in Gdynia and maritime administration).

2.5.6 Design, technology and organisational security measures expected to be applied by the Applicant

Design, technological and organisational security mainly relies on carrying out navigational risk assessments and developing prevention plans against:

- threats to human life – evacuation plans, search and rescue plans;
- fire hazards;
- threats of environmental pollution – a plan to counteract the threats and contamination by oil. The principle of the obligation to have a plan will apply not only to the facility, but also to all large and medium-sized vessels involved in the construction, exploitation and decommissioning of the OWF;
- threats of construction disasters – all structures are designed taking into account possible extreme conditions for at least double the operation period.

2.5.7 Potential causes of breakdowns including extreme situations and the risk of natural and construction disasters

The OWF constructions because of their purpose are designed and built with the idea of withstanding extremely difficult atmospheric conditions. All components, despite subjecting them to extremely high loads, are adapted to many years of use. All devices are subjected to continuous monitoring and each signal about the occurrence of deviations from the situation classified as a safe operation causes an automatic activation of remote service interventions or a change of operating parameters including stopping the devices. The rotor is stopped automatically at a wind speed exceeding safe speed for an operation of a wind power station. The service plan is to ensure flawless operation.

The greatest risks potentially occur during the construction phase; however, the risk of disaster is minimal due to the fact that the planning of offshore operations always takes into account weather conditions and the possibility of their change. Every offshore operation has its limitations in terms of visibility, wind speed, sea status (height of waves) or ambient temperatures. The occurrence of negative effects of climate change in the form of too strong wind or too high waves can only result in the extension of the construction cycle and an increased demand for energy – fuel consumption.

2.5.8 Risk of major breakdowns or natural and construction disasters, taking into account the substances and technologies applied, including the risk related to climate change

The risk of a major accident resulting in the emission of hazardous substances is minimal [346]. The probability of such events as ship collisions belongs to the category of very rare events (1 per 100 years), while events such as a vessel contact with the OWF construction remains in the category of very rare events (1 per 200 years). Taking into account the effects in the form of 200 m^3 of diesel oil emission, the risk level is within an acceptable range. Emission of 200 m^3 of diesel oil will cause insignificant damage to the environment because it will disperse within 12 hours [346].

2.6 Relations between the parameters of the project and its impacts

The matrix of connections between the project parameters and impacts is presented in the table (Table 2.9).

Table 2.9. A matrix of connections between project parameters and impacts [Source: internal materials]

Parameter	**Type of emission or disturbance**															
	Above-water structures	**Underwater structures**	**Heat**	**EMF**	**Above-water noise**	**Underwater noise**	**Waste**	**Light effects**	**Seabed disturbances**	**Suspended solids**	**Resuspension of contaminants**	**Resedimentation**	**Creation of “ artificial reef”**	**Water contamination**	**Air pollutions**	**Increased traffic and collision**
Number of wind power stations	X	X			X		X	X								X
Number of foundations or support structures		X				X	X		X	X	X	X	X	X		
Type of foundations or support structure and the width of the protection against washout						X			X	X	X	X	X	X		
Diameter of the foundation of support structure		X				X			X	X	X	X	X			
Piling parameters						X										
Full height of structure	X				X			X								X
Rotor diameter [m]	X															
Length and type of cables		X	X	X						X	X	X				X
Depth and method of cable laying/burying			X	X		X					X					
Number and size of substations	X	X		X	X			X								
Organization of technological processes (number of ships, time)					X	X	X	X						X	X	X

3 Environmental conditions

3.1 Location, seabed topography

The Baltic Power OWF Area is situated east of the Słupsk Bank and approx. 23.5 km north of the town of Łeba. The OWF Area (1 NM) covers a seabed section with a depth from 28.1 to 45.4 m, the area within the boundaries of the PSzW permit no. MFW/6/12 as amended, covers a seabed section with a depth from 31.9 to 45.4 m, while, the Development Area covers a seabed section with a depth from 33.9 to 45.4 m. The depth increases to the north (Figure 3.1).

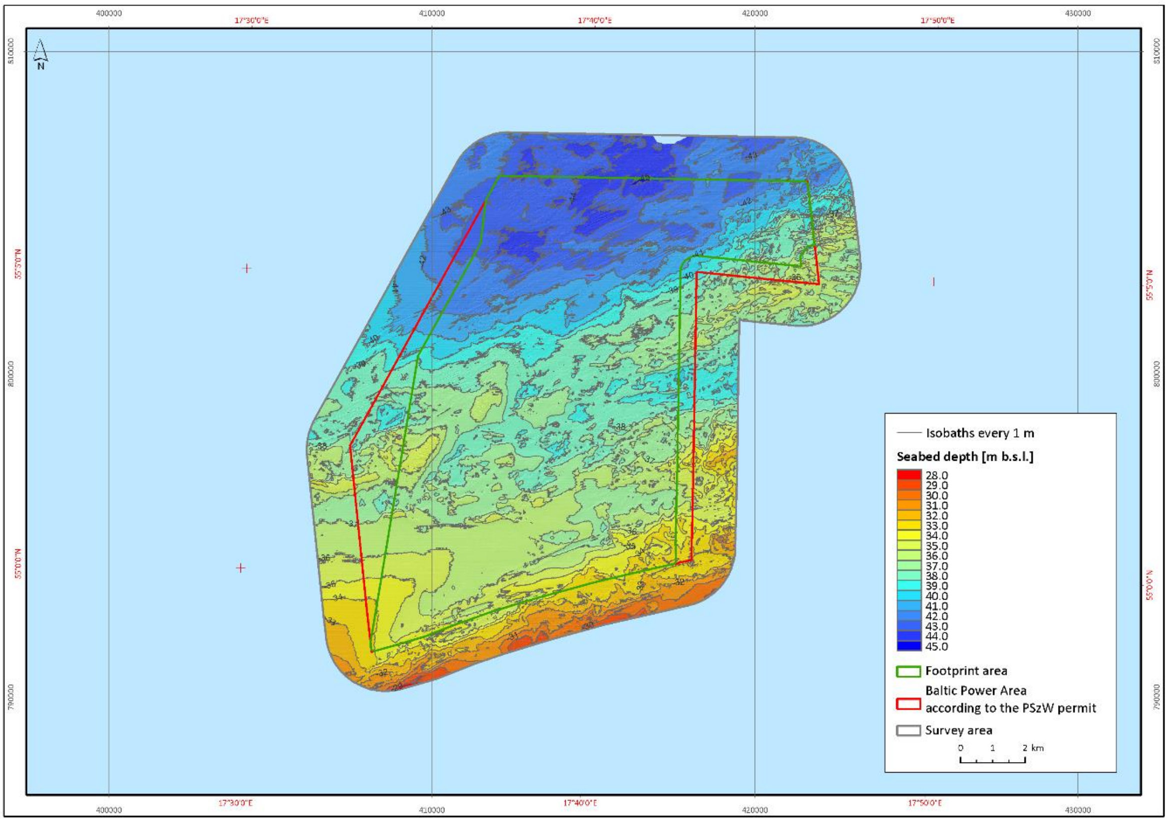


Figure 3.1. Bathymetric map of the Baltic Power OWF Area [Source: Baltic Power Sp. z o.o. data]

On the basis of the bathymetric and sonar data analysis, a full identification of the seabed surface relief and characteristics was carried out. On that basis, using the interpretation of seismic and seismo-acoustic data and the data from the analyses of surface and virbocorer samples, as well as taking into account the general knowledge about the area [89, 90, 164, 230, 231, 232, 233, 291, 328, 425, 424, 427, 428], a map of seabed surface types was created (Figure 3.2).

Within the area analysed, three seabed types, different in terms of structure and relief character, were distinguished (Figure 3.2):

- abrasive-accumulative plain (P1);
- kame terraces (P2);
- accumulation platform (P3).

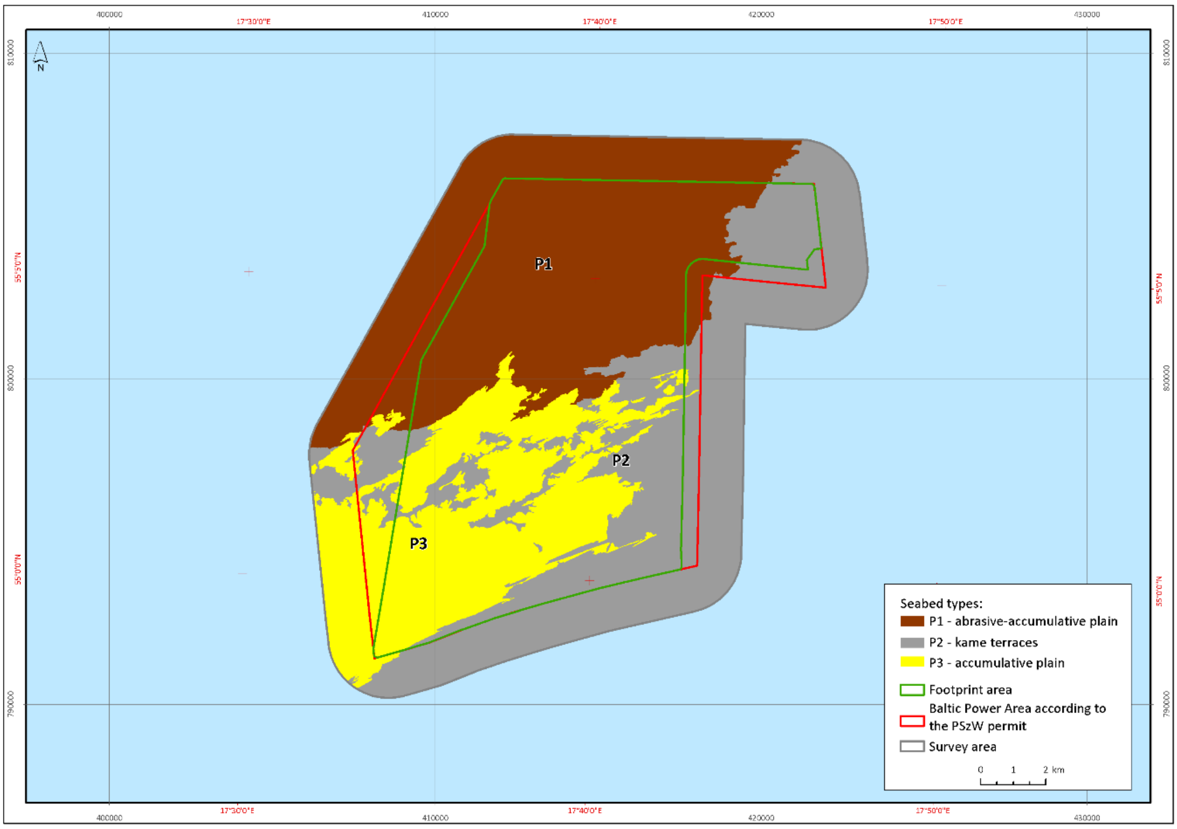


Figure 3.2. Map of seabed surface types in the OWF Area; abrasive-accumulative plain – brown, kame terraces – grey, accumulation platform – yellow [Source: Baltic Power Sp. z o.o. data]

Abrasive-accumulative plain (P1)

The north and north-western part of the OWF Area (1 NM) is an abrasive-accumulative plain (Figure 3.2). It covers the seabed with a depth from approx. 37.0 to approx. 45.7 m b.s.l. The seabed surface is level with small height differences (up to 0.5, maximally 1 m) associated with the presence of sand accumulations on the surface of cohesive sediments. Seabed slope is 2° to 3°.

Kame terraces (P2)

The seabed area with the most varied relief and structure was identified as the kame terraces area (Figure 3.2). It covers the central, eastern and southern part of the OWF Area with a depth from approx. 28.1 to 40.0 m b.s.l. The seabed surface is diversified with numerous hillocks up to 2.0 m (max. 3.0 m) above the surrounding seabed surface. Seabed slopes are up to 2–3°, in places, more than 20° – this applies only to the slopes of hillock moraine, crevasse fillings and till outcrops.

Accumulation platform (P3)

The central and south-western part of the OWF Area (1 NM) is an area of an accumulation platform character (Figure 3.2). It covers the seabed with a depth from approx. 31.0 to approx. 37.0 m. The seabed surface is slightly undulated, there are slight height differences associated with the presence of sand forms and outcrops of older sediments. Seabed slope is 2° to 3°, locally max. up to 5°.

The detailed data on the seabed topography of the area analysed, obtained on the basis of the surveys conducted, are included in Appendix 1 to the EIA Report.

3.2 Geological structure, seabed sediments, raw materials and deposits

3.2.1 Geological structure, geotechnical conditions

According to the data from literature [89, 164, 230, 231, 232, 233, 291, 328, 427, 428], Quaternary sediments deposited on the Paleogene and Neogene sediments were identified in the seabed structure of this area. Below the Paleogene and Neogene layer, the Mesozoic (Triassic and Cretaceous) sediments were identified. They occur only in the southern part of the survey area. Below the Mesozoic sediments in the northern part of the survey area, directly below the Paleogene and Neogene sediments, the Silurian sediments are present.

3.2.1.1 Sub-Quaternary sediments

The oldest, identified on the basis of the analysis of seismo-acoustic data, is the top of the sediments classified as pre-Quaternary. These are, most probably, sandy and sandy-silty sediments, in places, clayey sediments from the Paleogene and the Neogene. The tops of these sediments are situated at a depth of approx. 7–10 m below the seabed surface in the southern part and locally in the northern part, and up to approx. 30–40 m below the seabed surface in the central part.

3.2.1.2 Quaternary cover

The Quaternary cover forms a continuous layer consisting mainly of tills with a thickness from approx. 20 to 30 m [425]. Ice-marginal sediments (clay, silt, fine sand) are deposited on the till surface. The seabed surface consists mainly of fine sands, as well as silty sands and sandy silts in places. Tills occur in the deep structure of the entire area. In places, tills can form outcrops covered with a thin, discontinuous layer of sand and gravel.

The top surface of tills has a different character in the northern and southern part of the area. In the northern part, the till top is even, locally with erosive pavement on the surface. It is deposited shallowly under the seabed (at a depth of 0.5 to 1.0 m), with local outcrops on the seabed surface. In the southern part of the area analysed, the till top has a diversified, uneven surface with numerous height differences and depressions. The till top of the southern series is located at a depth of 10–15 m, more than 20 m below the seabed surface in places. In the southern direction, the deposition depth of the till top decreases and equals approx. 5–10 m below the seabed surface.

Ice-marginal sediments were identified in the southern part of the area analysed. Their range coincides with the range of the southern series of tills. Their top surface is even. The thickness of ice-marginal sediments is 10–15 m; southwards, it decreases to approx. 5–10 m. The top of ice-marginal sediments is situated at approx. 0.5–1.0 m below the seabed surface in the southern and south-eastern part, up to approx. 4 m below the seabed surface in the western part.

The prevailing part of the seabed surface in the area analysed is covered with a discontinuous, thin layer of fine- and medium-grained sands, locally silty sands and silts. The thickness of sand is low, approx. 0.5 to 1.0 m over a greater part of the area, in the central part it is 1.0 to 2.0 m, in places, in the lowerings of substratum top, up to 5.0–6.0 m. Accumulations of coarse sand and gravel as well as boulder clusters are present locally on the surface.

The detailed data on the seabed structure of the area analysed, obtained on the basis of the surveys conducted, are included in Appendix 1 to the EIA Report.

3.2.2 Seabed sediments and their quality

Almost the entire seabed surface of the area analysed is covered with a discontinuous layer of fine- and medium-grained sands. In places, accumulations of multi-grained sediments, boulder clusters and cohesive sediment outcrops occur on the surface.

The seabed surface within **the abrasive-accumulative plain** consists of a thin, discontinuous layer of sands with a thickness of up to approx. 0.5 m, deposited on a till substratum. The top of till is level with slight height differences. The till top surface is slightly inclined in the N and NW directions.

The seabed surface within **the kame terraces** consists mainly of sands, in places, of sands and silts, as well as tills in the form of outcrops and hillocks often with a stony cover with an erosive pavement character in the till top. Below the sandy and sandy-silty sediments, the seabed consists of till. Till top is uneven, with height differences of up to several meters.

The seabed surface within **the accumulation platform** consists of a layer of sands with a thickness of up to 1–2 m (locally up to 5–6 m, in the substratum top depressions), deposited mainly on a clayey-silty substratum (in places, silty-sandy and till substratum). The clayey-silty sediment top is level, with height differences of up to several meters in places.

Two types of sediments forming the seabed surface were distinguished on the map of sediment types in the Baltic Power OWF Area (Figure 3.3): fine- and medium-grained sands, and till with a stony-gravel abrasive pavement and a sandy cover.

The fine- and medium-grained sands in the OWF Area form mainly compact covers with flat surfaces. Within their area, the sand layer thickness is up to several meters. Their range coincides, to a large degree, with the range of the accumulation platform.

Tills with a stony-gravel abrasive pavement and a sandy cover form areas of diverse relief with fields of ripple marks moving over the till surface and abrasive pavement. Locally, the seabed surface consists solely of abrasive pavement on till.

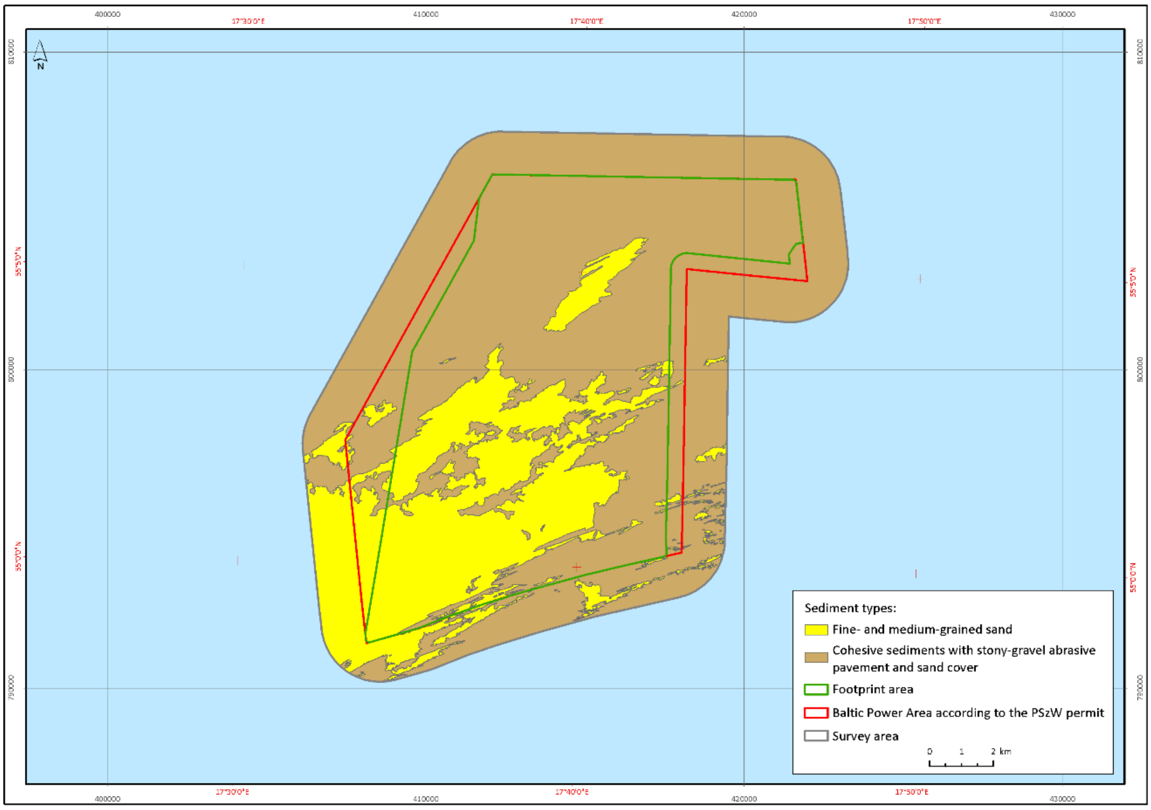


Figure 3.3. Map of surface sediments in the OWF Area [Source: Baltic Power Sp. z o.o. data]

Seabed sediments constitute a very important element of the aquatic ecosystem of the Baltic Sea, which is a shallow sea, with limited water exchange and a surface area approximately four times smaller than its catchment area. Such conditions mean that every interference in the marine environment, including the exploitation and development of the seabed, affects the delicate ecological balance of the marine ecosystem.

The transfer of contaminants from the sediment into the water (and thus, the change of water quality), and the formation of suspended solids that remain suspended in the water for a long time, depends on the type of sediment. The most contaminants and nutrients will be transferred into the water from a sediment with an increased amount of organic matter (e.g. silty, clayey sediments, characterised by higher concentrations of metals and persistent organic pollutants). Such sediments will also facilitate the formation of a greater amount of suspended solids, which will remain suspended in the water for a long time. Intensive resuspension can cause the nutrients immobilised in the sediment to be released and contribute to eutrophication. In the case of sandy sediments with low organic matter content (e.g. sandy coarse-grained sediments), the described processes will advance less intensely. These sediments are generally characterised by a small number of fine fractions and low concentrations of metals and persistent organic pollutants.

The surface seabed sediments analysed from the Baltic Power OWF Area belong to inorganic sediments with the organic matter content expressed as loss on ignition (LOI)) of less than 10%.

Seabed sediments collected during the environmental surveys were analysed in terms of nutrient, persistent organic pollutants (POPs) (i.e. PAHs, PCBs, TBT, mineral oils) and metal content.

None of the sediment samples tested exceeded the limit values specified for the concentration of metals, polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCB), in the

Regulation of the Minister of the Environment of 11 May 2015 on the recovery of waste outside installations and facilities (Journal of Laws of 2015, item 796), which allows the classification of a sediment as clean in the context of practical applications, and although the limit values do not relate to a sediment transferred within water, they may form the basis for assessing the seabed sediment contamination with chemical compounds.

Nutrients

Primary processes influencing the **nutrient** content in the sea are the geophysical and geochemical processes, which control not only the supply of such elements to seawater, but are also responsible for the dispersion and removal of such compounds.

Nitrogen compounds present in the seabed sediments undergo cyclical changes as a result of biogeochemical processes. Oxidation of ammonia and its compounds by the nitrifying bacteria leads to formation of nitrogen oxides, and later nitrates. Too intensive nitrification, however, is not desirable, as nitrates are more easily eluted form sediments than ammonium ions. The processes related to the construction (laying) of foundations or a support structure, vessel anchoring or cable burying can result in a better oxygenation of sediments, and consequently an intensification of nitrification processes and a magnified release of nitrates to water. This can also affect the balance of the general scheme of nitrogen cycle by reducing the intensity of denitrification processes that occur under anaerobic conditions and involve the conversion of nitrates into molecular nitrogen [305, 422].

In the Baltic Sea sediments, nitrogen occurs mainly in organic form and its regional variability is analogous to the variability of carbon [66]. Usually, inorganic forms of nitrogen constitute no more than 10% of the total nitrogen in the sediments [67]. An increase in the percentage share of inorganic nitrogen forms is possible in the area of erosion and transport of fine particle dispersion sediments [424].

Due to the fact that the circulation of nitrogen in the environment is a very complex process, the intensity of which depends on many factors (e.g. oxygenation, temperature, season, primary production, etc.), as well as on the size of nutrient supply from the point or diffused sources, and the deposition from the atmosphere [57, 136], a precise calculation of the nitrogen load, which would enter the water column from a sediment during construction work is impossible. During the survey cycle conducted, no analyses of the total nitrogen content in the seabed sediments of the area discussed were carried out, thus, for a very general estimation of the load of this element that could enter the water depth during the work performed, the data from literature and from own studies concerning its content in the sediments of the central coast were used. According to the data from literature, the nitrogen content in the Southern Baltic sediments falls between 98–2604 mg $N \cdot kg^{-1}$ DW in sandy sediments, 1106–3094 mg $N \cdot kg^{-1}$ DW in sandy-clayey sediments, 1904–9506 mg $N \cdot kg^{-1}$ DW in clays and 1694–4606 mg $N \cdot kg^{-1}$ DW in tills [319], and in the own studies, the total nitrogen content both in summer, as well as in winter was below the limit of quantification of the method applied i.e. below 200 $mg \cdot kg^{-1}$ DW in the sandy seabed sediments of the central coast. Taking into consideration the above data, it was established that the nitrogen amount, which could transfer from the sediment to the water depth during construction works will be negligible in comparison to approx. 190 000 tons of the total nitrogen supplied to the Baltic Sea each year with the inflowing river waters [424].

Phosphorus (P) in the seabed sediments is conventionally divided into labile (mobile, reactive) and refractive. Refractive forms are a combination of phosphorus with calcium, aluminium and clay minerals, as well as degradation-resistant organic forms of this element. Refractive phosphorus is subject to deposition, and thus, is removed from the circulation in the water depth. Labile phosphorus is the phosphorus contained in fresh organic matter, phosphates present in the interstitial waters, the combinations of phosphorus with Fe^{3+} and phosphates loosely bound by adsorption with different elements of the sediment. Such forms easily re-enter the circulation in the water depth, mainly due to the mineralisation of organic matter and the dissolution of combinations of phosphorus with Fe^{3+} as a result of the decrease in the value of the redox potential [8, 424]. Phosphorus can act as a productivity-limiting factor for the marine ecosystems [445]. In aquatic environment, when the primary production is limited by the quantity of phosphorus, an introduction of 1 mg of phosphorus means a 100 mg growth of algae dry weight per single, biological cycle [107].

The nutrient content (here – the total phosphorus content) in the area surveyed did not exceed the values typical for the sediments of the Southern Baltic. The amount of phosphorus that may be released into the water (the so-called available phosphorus) is estimated at 10 to 20% of the total amount of phosphorus contained in the sediments [463]. The average phosphorus concentration in the sediments surveyed was 331 $mg \cdot kg^{-1}$ DW in winter and 336 $mg \cdot kg^{-1}$ DW in summer.

The concentrations of persistent organic pollutants (**PAHs, PCBs**) and harmful substances such as metals or mineral oils, in the area surveyed were low and did not exceed the values typical for the sandy sediments of the Southern Baltic.

PAHs and PCBs present in the sediments may undergo numerous transformations and have a significant impact on the environment. The scope of impact depends on the transformations that these compounds undergo. These can be abiotic processes such as sorption, elution, oxidation, photodegradation, reactions with other compounds, and biological processes such as microbiological transformations. They may inhibit or stimulate the growth of microorganisms, have a phytotoxic or stimulating impact on the growth of plants, as well as be toxic to fauna [143]. The accumulation of PAHs and PSBs in sediments is facilitated, among others, by a high percentage of silt and clay fractions with sediment particles with a size of <0.063 mm, and characterised by a large specific surface area and a significant ability to adsorb hydrophobic pollutants and organic compounds of phosphorus, sulphur, and nitrogen.

Pyrogenic PAHs as well as PCBs, exhibit an exceptionally high persistence in seabed sediments, which is caused by the occlusion of these chemical compounds in very fine sediment particles [50]. Therefore, the phenomenon of desorption of these substances from the sediments into the water is limited. Usually, it is maximally 0.5% for PCB congeners, and up to 5% for the analytes from the PAH group [152, 151]. Assuming that such amounts of these substances will transfer to the water, it can be concluded that the risk of water contamination related to the remobilisation of PAHs and PCBs in the area surveyed is insignificant.

PAH and PCB concentrations in the sediments surveyed (dry weight) and their availability are presented in the table (Table 3.1).

Table 3.1. Concentrations of PAHs and PCBs in the seabed sediments surveyed [Source: Baltic Power Sp. z o.o. data]

Indicator	**Concentration in the sediments surveyed (calculated as dry weight) [$mg \cdot kg^{-1}$ DW]**	**Available form [%]**
Congeners from the PCB group	<0.0001	0.5
Analytes from the PAHs group	<0.001 to 0.276	5

Metal concentrations in the sediments surveyed in the Baltic Power OWF Area were low. Additionally, their availability (i.e. the ability to permeate into the water), which depends on their physico-chemical form, should be taken into consideration [372]. Metals permanently bound in the crystalline structure of minerals are immobilised and will not transfer into the water in natural conditions. While, metals in the mobile (labile) form are prone to permeating into the water from the sediment [372, 100, 383].

The labile form of metals may constitute (depending on the type of sediment in the case of individual metals) from 30 to 80% [366, 315, 372, 429, 100, 94]. The results of the analysis of the metal labile form in the sediments surveyed showed that in unfavourable conditions approx. 70% of lead and approx. 65% of copper and zinc can transfer from the sediment into the water. In the case of nickel and chromium, which are more permanently bound with the sediment, this can occur in approx. 43% and 22%, respectively.

The average concentrations of metals in the sediments surveyed (dry weight) and the concentrations of the labile form are presented in the table (Table 3.2).

Table 3.2. Average concentration of metals in the seabed sediments surveyed [Source: Baltic Power Sp. z o.o. data]

Metal	**Average concentration of the total content in the sediments surveyed (calculated as dry weight) [mg·kg^{-1} DW]**	**Average concentration of the available form (labile) [mg·kg^{-1} DW]**
Lead (Pb)	3.62	2.47
Copper (Cu)	1.19	0.78
Zinc (Zn)	9.28	5.52
Nickel (Ni)	1.73	0.75
Chromium (Cr)	4.34	0.97

The concentrations of arsenic (LOQ <0.25 mg·kg^{-1} DW), cadmium (LOQ <0.05 mg·kg^{-1} DW), mercury (LOQ <0.01 mg·kg^{-1} DW) and TBT in the sediment surveyed were trace, and usually below the lower limit of quantification. Consequently, the risk of contamination of waters related to the remobilisation of such chemical compounds from the seabed sediment during the construction of the OWF was acknowledged as negligible and no further analyses were conducted.

The sediments surveyed were also characterised by a low activity of the radioactive isotope of caesium ^{137}Cs, typical for sandy sediments.

3.2.3 Raw materials and deposits

In order to identify potential areas of raw materials useful for future exploitation in the OWF Area, the seismo-acoustic and bathymetric data, as well as data from the analyses of the sediment samples collected with a vibrocorer were analysed. In the seabed structure of the area analysed, no parameters appropriate for the accumulations of fine and medium sand, which could constitute a mineral deposit [pursuant to the Act of 9 June 2011 – Geological and Mining Law (Journal of Laws of 2011, No. 163, item 981) and the Regulation of the Minister of the Environment of 1 July 2015 on the geological documentation of the mineral deposit, excluding hydrocarbons (Journal of Laws of 2015, item 987)] were recognised. Sands identified create a layer with a thickness of 0.5 to 2 m, and only locally up to several meters. Sands are deposited on a silty-clayey substrate, locally on a till substrate.

According to the Regulation of the Minister of the Environment of 1 July 2015 on the geological documentation of the mineral deposit, excluding hydrocarbons (Journal of Laws of 2015, item 987), a deposit should have an at least 2 m thickness (limit values for the parameters defining a deposit and its boundaries for individual minerals – gravel deposits, gravelly-sand and sandy-gravel with a sand point below 75%). The areas, within which the sand cover thickness exceeds 2 m, are small and scattered unevenly around the southern part of the area (mainly in its northern and south-western part), and the thickness of sands within them often does not exceed 2.5 m, and only locally, even pointwise reaching up to 5–6 m. The detailed results of the surveys conducted concerning the potential natural aggregate deposits are included in Appendix 1 to the EIA Report.

The difficulty in conducting analyses aimed at identifying the potential areas of raw material occurrence is the fact that there are no precise qualification criteria in the currently binding laws that refer to aggregate deposits in the marine areas.

The detailed results of the sediment surveys conducted concerning the occurrence of potential mineral aggregate deposits are included in Appendix 1 to the EIA Report.

3.3 Seawater quality

The results of tests of individual chemical parameters of water in the Baltic Power OWF Area, such as pH level, oxygenation, 5-day biochemical oxygen demand (BOD_5), total organic carbon (TOC), nutrients, PCBs, PAHs, mineral oil, cyanides, metals, phenols, caesium, strontium, did not diverge essentially from the contents typical for the waters of the Southern Baltic.

These waters were characterised by an alkaline pH (pH from 7.8 to 8.4), alkalinity of approx. 1.7 $mmol \cdot dm^{-3}$ and a relatively good oxygenation, with seasonal variability characteristic of the Southern Baltic waters. The assessment of the water quality index in the OWF Area, on the basis of the oxygen content in the near-seabed layer in summer (VI/VII), indicates a good water status (no oxygen deficit). The average contents of dissolved oxygen during this period were above the limit value of 6.0 $mg \cdot dm^{-3}$ [240].

Within the entire survey period (January 2019–December 2019), the average biochemical oxygen demand (BOD_5) in the water samples collected from the Baltic Power OWF Area in individual measurement periods was below 2.00 $mg \cdot dm^{-3}$. Also, the content of suspended solids in particular measurement periods was at a level typical for the waters of the Southern Baltic. The lowest average concentration of suspended solids in the area surveyed was in the autumn-winter period, while, the highest in May, which could have been caused by the increased primary production and in December by the agitation and mixing of waters in the stormy period.

The content of nutrients, total nitrogen, mineral nitrogen (nitrates, nitrites and ammonia), phosphates and total phosphorus, in the waters surveyed, was characterised by seasonal variability typical for the waters of the Southern Baltic. The lowest concentrations of the substances surveyed were present in the period from May to July, while, in the winter months (December–January), their significant increase was observed in accordance with the seasonal trend of nutrient level restoration.

The waters of the region surveyed were characterised by a low contents of particularly harmful substances. Trace concentrations of the following substances were present: polychlorinated biphenyls (PCBs), mineral oils (mineral oil index), free and bound cyanides, metals [Pb, Cd, Cr, Cr(VI), As, Ni, Hg] and phenols.

The waters tested were also characterised by low activity values of caesium ^{137}Cs and strontium ^{90}Sr, typical for the waters of the Southern Baltic, which confirms a slow downward trend of ^{90}Sr and ^{137}Cs concentration in the Baltic Sea area [469].

In the Baltic Power OWF Area, a slightly higher PAH concentrations were observed, than the ones specified by the data from literature [171, 464], which may result from the differences at the stage of sample preparation for analyses (PAHs were determined in water without the separation of suspended solids).

Comparing the results obtained for the indicators of the waters surveyed with the limit values specified in the Regulation of the Minister of Maritime Economy and Inland Navigation of 11 October 2019 on the classification of ecological status, ecological potential, chemical status and the method of classifying the status of surface water bodies as well as environmental quality standards for priority substances (Journal of Laws of 2019, item 2149) and the proceeding Regulation of the Minister of the Environment of 21 July 2016 on the method of classifying the status of water bodies and environmental quality standards for priority substances (Journal of Laws of 2016, item 1187) – legal basis repealed from 2 July 2019, the physicochemical elements analysed in the Baltic Power OWF Area surveyed can be assigned class 1 of water quality (very good status) due to the value of the following indicators: dissolved oxygen, inorganic nitrogen compounds (in winter), nitrite nitrogen, total phosphorus and TOC (in summer), free and bound cyanides, mineral oil index, phenols and metals [As, Cr (VI), Cu]. Due to the value of an indicator – total nitrogen, which was assigned class 2 of water quality, and due to the value of an indicator – phosphate phosphorus, which did not fulfil the requirements of class 2 of water quality, the area surveyed did not attain a good status.

Despite a very small difference in concentrations, in comparison to the data from literature of 2002, no exeedance of limit values of the water quality indicators specified in the above-mentioned Regulation for PAHs [anthracene, fluoranthene, naphthalene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene] was found. No exeedances of the indicator limit values for the following elements were found: cadmium, lead, mercury and nickel.

Taking into consideration the distance of the Baltic Power OWF Development Area to the nearest surface water body, i.e. Jastrzębia Góra – Rowy CWIIIWB5, which is more than 21 km away and the impact range of the project, it should be assumed that the implementation of the Baltic Power OWF shall have no impact on the achievement of the environmental objectives for this surface water body.

3.4 Climatic conditions and state of the air

3.4.1 Climate and the risk related to climate change

The area of the Southern Baltic is located in the humid temperate climate zone with the influence of the Atlantic climate due to prevailing oceanic winds. The vicinity of the Atlantic Ocean with the inflow of large masses of air, to a large degree, determines the climate of the Baltic Sea region. As a result, winters are mild and warmer than in the northern part of Europe, while summers are colder than in the southern part of Europe. Additionally, the Southern Baltic area is characterised by a regular occurrence of strong winds from the western and south-western directions and high air humidity.

In the PMA, including the coastal zone, multi-annual recordings of the following parameters have been conducted: air (pressure, temperature and humidity), wind conditions (direction and speed), insolation, amount and type of precipitation as well as water (temperature and salinity), and hydrodynamic conditions (sea level, flows and wave motion). These are conducted both at coastal stations and in the open sea. In particular, the comprehensive surveys that have been performed operationally for several decades now by IMWM-NRI at stations and measuring points, and for several years also on buoys anchored in the sea could be mentioned here. In addition, IMWM-NRI performs monitoring surveys in the Southern Baltic area several times a year, recording the hydrophysical and physico-chemical parameters of the sea according to a designated grid of points. Hydrological and meteorological surveys are also carried out by other scientific and research units. Wind, air temperature and humidity, and also the average sea level are measured at the Coastal Research Station (CRS) Lubiatowo, owned by the Institute of Hydro-Engineering of the Polish Academy of Science (IHE PAS), while, the Institute of Oceanology of the Polish Academy of Sciences with a monitoring station located at the Sopot Pier, monitors air temperature, pressure and humidity, insolation, as well as seawater temperature and salinity. As part of the SatBałtyk project carried out in 2010−2015, satellite measurements were conducted enabling the determination of the characteristics of the sea and atmosphere in the form of maps presenting, for example, temperature distributions, ice covers, momentary water flow velocity, water mixing and turbidity. Within the last dozen or so years, at various locations within the Polish Exclusive Economic Zone, recordings of the near-water layer parameters and hydrophysical and dynamic quantities in the entire water depth have been conducted by the MI GMU as part of various research projects and at the request of investors.

The surveys presented which are associated with similar recordings conducted by the neighbouring Baltic countries allow to determine the current trends and anticipated directions of changes in the basic climatic parameters of the Southern Baltic. Additionally, the information from simulation calculations of the climatological numerical models of the Global Atmospheric Circulation Model available, for example, from the research conducted as part of the BALTEX Assessment of Climate Change for the Baltic Sea Basin are used for the above-mentioned determinations.

The climate specific for the coast and the adjacent sea areas can be classified as a coastal strip climate with small air temperature amplitudes, high humidity, mild winters, cooler summers and strong winds. Winds from the west and south-west directions prevail. In the open sea areas, including the Baltic Power OWF Area, climatic conditions are characterised by lower air temperature amplitudes, and the average wind velocities are higher than in the adjacent land areas.

On the basis of the data and analyses available, it is possible to present the most important forecasts of changes of particular elements of the atmosphere and water in the Baltic Sea region:

- the increase in air temperature is faster there than the average global increase, this trend will continue;
- the increase in surface water temperature is greater than in its deeper layers, this may result in stronger thermal stratification and the stabilisation of the thermocline throughout the year;
- the predicted salinity changes are not clearly defined and depend, on the one hand, on the changes in the air circulation conditions and the volume of water exchange with the North Sea and, on the other hand, on the volume of river water inflow; a decrease in salinity level is predicted;
- an increase in atmospheric precipitation is forecast for the entire Baltic Sea basin in winter, while in summer only in the northern part; the prevalence of extreme precipitation will increase;
- in terms of forecasting the changes in sea level, the effects of its global increase will not be felt to a significant extent. This is due to the fact that the Baltic Sea, which is a relatively small and shallow shelf sea, is connected with the North Sea by the rather narrow Danish straits, through which an exchange of oceanic waters (the so-called inflows) takes place only incidentally. Moreover, most of its area (in the northern part) is located within the Scandinavian plate, which is characterised by visible uplift processes (so-called isostatic rebound), which result in a decrease of the average sea level. However, in the southern part, the impact of these processes is practically negligible, and the height of the water level is determined mainly by the atmospheric circulation conditions;

- forecasts of wind climate changes are subject to considerable uncertainty, it is assumed that with the increase in the average surface water temperature, the average wind velocity over sea areas will increase;
- changes in wave climate are mainly related to the increase in the frequency and intensity of storms – an increase in the number of extreme phenomena is forecast;
- model calculations indicate that there will be an increase in the surface area of low oxygen content areas and anaerobic areas near the seabed.

Forecasts of the climate changes for the territory of Poland, including the coastal zone and maritime areas under the jurisdiction of the Polish state, as well as scenarios of adaptation operations aimed at mitigating and counteracting the effects of changes are the subject of intensive work carried out by the Ministry of the Environment (currently the Ministry of Climate) and the Institute of Environmental Protection, as part of the "Polish National Strategy for Adaptation to Climate Change by 2020 with the perspective by 2030" (SPA 2020) [290] and the KLIMADA project.

Taking into account the conclusions and recommendations related to the coast and adjacent areas of the Baltic Sea, it was concluded that the observed and projected climate changes will have a negative impact on the functioning of coastal zones. An adverse influence of the periodic sea level rises is predicted there, resulting mainly from the increase in frequency and intensity of heavy storms. In the case of the Baltic Sea, this refers to a possible increase in the number, intensity and duration of storms, with an increase in the irregularity of their occurrence, i.e. after long periods of relative calm, series of rapidly succeeding storms of considerable force may occur.

An additional factor that accelerates the process of coastal erosion is the warming of winters, as a result of which, a reduction in the ice cover, which protects the beaches from storm surges, and thereby safeguards them against coastal erosion, should be expected. The scenarios of sea level changes demonstrate that in the period 2011–2030 the average annual sea level along the entire coast will be by approx. 5 cm higher in comparison to the values from the reference period, i.e. 1971–1990. An increase in the frequency of storm floods and more frequent flooding of low-lying areas, as well as the degradation of the coastal cliffs and sea shore, which will entail a strong pressure on the infrastructure located in these areas, are very important effects of the climate change.

Due to the increase in the average water temperature and an increased inflow of biogenic pollutants into the sea (nitrogen and phosphorus compounds), a negative phenomenon that will occur will be the progressive eutrophication, especially on the water surface (algea blooms).

The activities undertaken as part of the near-shore zone adaptation to the climate change concern the areas situated along the Baltic Sea coastline. However, there are no detailed guidelines and recommendations relating to the open sea areas, including installations and structures located there, which present the scope of activities aimed at counteracting the effects of the climatic condition changes forecast.

3.4.2 Meteorological conditions

The meteorological conditions of the sea areas encompassing the Baltic Power OWF Area were specified on the basis of the surveys of the near-water layer parameters conducted from January 2019 to February 2020. These are characterised on the basis of wind velocity and direction, air temperature, pressure and humidity recorded by an automatic atmosphere monitoring station (at a height of approx. 4 m a.s.l.). The basic statistical parameters obtained for the period specified are included in the table (Table 3.3).

Table 3.3. Statistical analysis of meteorological parameters measured at the HM_01 survey station in the period from 25 January 2019 (00:00) to 22 February 2020 (00:00) [Source: Baltic Power Sp. z o.o. data]

Parameter	**Vessel**	**Value**			
		Mean	**Minimum**	**Maximum**	**Median**
Relative humidity	[%]	83.24	44.15	99.37	84.76
Atmospheric pressure	[hPa]	1012.98	975.68	1046.39	1013.48
Air temperature	[°C]	9.49	-3.06	28.34	7.50
Wind speed	[$m \cdot s^{-1}$]	7.29	0.07	17.94	7.22
Dominant wind direction	-	SWW, SW, W			

3.4.3 Quality of air

Due to the lack of detailed information on the current parameters of air purity over the sea area intended for the construction of the Baltic Power OWF, the assessment of air quality in the near-water atmosphere layer was compared with the information obtained as a result of the surveys carried out by the Inspection for Environmental Protection as part of the State Environmental Monitoring (SEM) for the nearest coastal station (Łeba). However, it should be noted that due to the lack of significant pollution emission sources over the sea area, parameters of air purity should not be worse than those measured at the shore.

The assessment of air quality in Poland, including coastal stations, was carried out on the basis of the Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe. In the territory of Poland, the tasks related to the conducting of environmental surveys and assessments, including the air quality monitoring, are carried out by the Inspection for Environmental Protection as part of the State Environmental Monitoring (SEM), the program of which has been developed by the Chief Inspector for Environmental Protection (CIEP) and approved by the Minister of the Environment. Under this programme, tasks related to the fulfilment of requirements contained in the EU regulations and Polish law, as well as international conventions signed and ratified by Poland are performed. Currently, the State Environmental Monitoring (SEM) programme for the years 2016–2020 is being implemented.

Due to the fact that air quality monitoring is conducted only in the terrestrial areas, the results obtained from the surveys for the Pomeranian Voivodeship, and in particular, for the coastal strip zone, are treated as a reference level for the sea areas. For the majority of substances measured by the Inspection for Environmental Protection, the concentration criteria, corresponding to the quality class A, with the exception of the suspended dust PM10 level and benzo(a)pyrene contained in dust PM10, were obtained in 2018.

In the sea areas, which encompass the regions of the planned Baltic Power OWF, no measurements were conducted enabling the assessment of air quality in terms of greenhouse gases content, concentrations of dust and other harmful volatile substances. The nearest location, in which the monitoring of the above-mentioned air pollutants was conducted, was the coastal research station in Łeba. On the basis of the latest survey data provided by the Voivodeship Inspectorate for Environmental Protection (VIEP) in Gdańsk, the following concentrations of substances were found:

- sulphur dioxide (SO_2) – the fourth maximum 24-hour concentration in 2018 amounted to 5 $\mu g \cdot m^{-3}$ with a permissible value of 125 $\mu g \cdot m^{-3}$; this is the second lowest value recorded in the Pomeranian Voivodeship after Szadółki;

- nitrogen dioxide (NO_2) – the average 24-hour concentration in 2018 amounted to 5 $\mu g \cdot m^{-3}$ with a permissible value of 40 $\mu g \cdot m^{-3}$; this is the lowest value recorded in the Pomeranian Voivodeship;
- ozone (NO_2) – the number of days with an exceedance of the 8-hour average was 12, with the assumed target value of 120 $\mu g \cdot m^{-3}$ – this is the second highest value recorded in the Pomeranian Voivodeship;

In accordance with the assessment contained in the VIEP report, the applicable criteria concerning the target level for the protection of human health and plant protection are met in the Pomeranian Voivodeship.

Such level of the values recorded is the reason that the area of the coastal zones in the vicinity of Łeba has air quality class A. While, the open sea areas intended for the construction of the Baltic Power OWF are situated at a considerable distance from the terrestrial sources of SO_2 and NO_2 emissions. These substances are emitted only by vessels, however, the emission amounts depend on the traffic intensity and type of vessels. The Baltic Power OWF Area is free of any terrain obstacles hindering the spread of these substances. Therefore, the average concentrations of the above-mentioned compounds in the air should have significantly lower values. On the basis of the data on ship traffic in the years 2018–2019 obtained using the IWRAP [IALA Waterway Risk Assessment Programme, official model of the International Association of Lighthouse Authorities (IALA) (an international organisation responsible for the safety of navigation), it was calculated that in the area delineated with the coordinates 55°30’ N; 16°00’ E and 54° 00’ N; 19°00’ E (Figure 3.4), throughout a year, vessels consume more than 100 000 Mg of fuel, emitting more than 300 000 Mg of CO_2, more than 5000 Mg of SO_2, more than 9500 Mg of NO_x and more than 700 Mg of dusts.

Taking into consideration the parameters of the currently used marine fuels, resulting from the applicable regulations, the actual emissions from the combustion of fuels may be significantly lower than the ones calculated using the IWRAP programme.

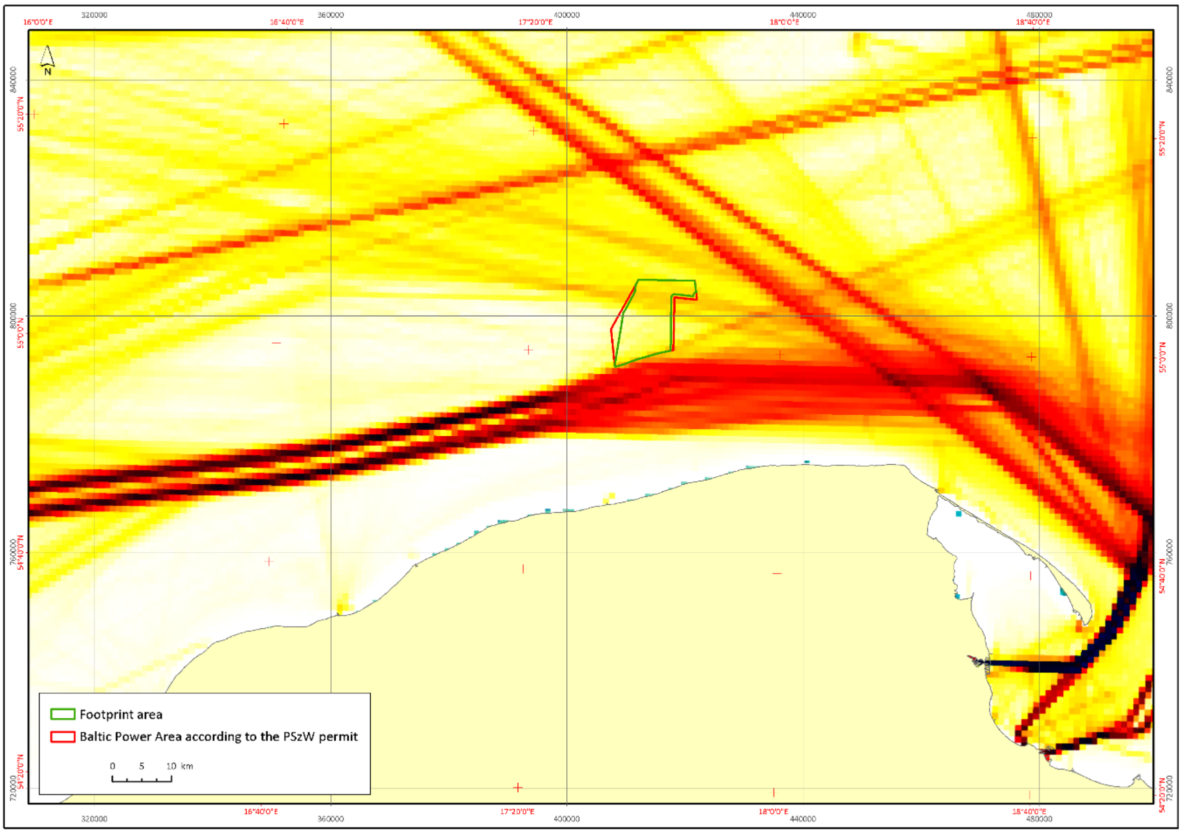


Figure 3.4. Distributions of pollutant emissions from the vessels sailing in the vicinity of the Baltic Power OWF in the years 2018–2019; darker colour means greater relative emission from the combustion of vessel fuels [Source: internal materials based on AIS data]

In the case of O_3 concentration, which has a higher value in the coastal region than in the inland locations, it can be assumed that O_3 concentrations in the open sea will not differ significantly from the ones recorded in the coastal zone, although it can be assumed that due to emissions from transport being lower here than on land (the O_3 precursors are, for example, nitrogen oxides from transport), such concentrations will be also negligible. Such continual O_3 concentration is due largely to natural causes.

3.5 Ambient noise

To determine the initial level of ambient noise, noise monitoring was conducted using a SM2M Wildlife Acoustics autonomous sound recorder.

The results of ambient noise monitoring conducted in the period from January 2019 to January 2020 in the Baltic Power OWF Area, show that the levels of underwater noise (and their variability ranges) indicate values characteristic for the Southern Baltic area [222, 294]. The comparison of the results obtained with the model data acquired using the BIAS platform Soundscape Planning Tool [142, 435] for the OWF Area, indicated that the results of ambient noise monitoring presented in this report are in a certain concordance with the BIAS project results, which also confirm the seasonal variability of the noise level, as well as the occurrence of higher sound pressure (SPL) values in the winter period.

More details are included in Appendix 1 to the EIA Report.

3.6 Electromagnetic field

Electromagnetic fields in the environment can be divided into natural fields and fields of anthropogenic origin (called artificial fields). Among natural fields, the best recognisable is the Earth's geomagnetic field, the intensity of which is from 16 to 56 $A \cdot m^{-1}$. On the surface of the Earth, an electric charge is accumulated, which is the source of the natural electric field. The intensity value of the Earth's natural electric field at moderate weather conditions is approximately 120 $V \cdot m^{-1}$.

In the marine environment, the values of electric field and the geomagnetic field are similar. In the Baltic Power OWF Area, there are no artificial sources of electromagnetic field. The existing DC transmission system between Poland and Sweden (SwePol Link) is located at a distance of several dozen kilometres away from the planned OWF location.

Changes in the natural electric fields do not have a direct impact on the living organisms. Natural magnetic fields show differences depending on the geographical location. They have a significant impact on some living organisms.

Electromagnetic fields created as a result of electric current flow can change the natural migratory behaviour in marine mammals and fish, they can also be the source of thermal energy introduced into the marine environment. No indicators have yet been developed for the assessment of the state of the marine environment for the descriptor W11, including indicator 11.4.1 "Strength and spatial range of electromagnetic and electric fields". These factors are not currently monitored in PMA [153].

3.7 Description of the natural environment components and protected areas

3.7.1 Biotic elements in the marine area

3.7.1.1 Phytobenthos

Surveys conducted in the zone accepted for construction and in the 1 NM wide area from the boundary of this zone, indicated lack of underwater vegetation, both rooted in the seabed sediment and attached to the boulders and stones deposited on the seabed. The previous studies conducted in the PMA has shown that phytobenthos is present up to a depth of approx. 22 m, i.e. up to the scope of the euphotic zone [382, 383, 132, 238, 387]. The minimum seabed depth in the survey area is 28 m, which is below the scope limit of phytobenthos, therefore, it should be assumed that phytobenthos does not occur in the entire Baltic Power Development Area.

3.7.1.2 Macrozoobenthos

Macrozoobenthos (seabed macrofauna) is a group of invertebrate organisms living on the surface layer of seabed sediments (epifauna), as well as the hard substratum (boulders, stones) or living inside the sediments (infauna), which remain on a sieve with a mesh size of 1 mm during sediment rinsing. The macrozoobenthos composition includes mainly the Bivalvia, the Crustaceans, the Polychaete, the Oligochaeta and the Gastropoda. These are mostly sessile organisms with a life-cycle of at least one year. Macrozoobenthos plays an important role in the trophic network of marine ecosystems. The benthic invertebrates are food for many species of fish and marine birds. Moreover, they shape the living conditions of other organisms (habitat-forming role) and influence the state of the environment (e.g. sediment oxygenation, biofiltration of suspended solids from water). Taxonomic diversity, abundance and sensitivity of individual taxa constituting the complex of benthic organisms are indicative of the ecological quality of the seabed.

For the purposes of this report, separate surveys of macrozoobenthos on the soft bottom (sandy sediments) and on the hard bottom (boulders, stones) were conducted. On the soft bottom in the OWF

Area (1 NM), a presence of 25 taxa was confirmed, which belonged to a single phylum, 6 classes and a single subclass, among which the group of absolutely constant species included the polychaetes *Marenzelleria* sp. and *Pygospio elegans*. On the hard bottom, 16 taxa belonging to 6 classes and a single subclass were recorded. Bay mussel *Mytilus* sp. dominated in the abundance and biomass structures.

The Baltic Power OWF Area is situated in the Eastern Gotland Basin. The nearest stations, at which macrozoobenthos surveys are conducted as part of the SEM programme, are located at a distance of 15–30 km from the OWF Area boundary, within a different depth range, therefore, there is no historical data available on macrozoobenthos in the planned OWF region. However, the results contained in the Reports on macrozoobenthos surveys in the Bałtyk III OWF [383], Bałtyk II OWF [382] and Baltic OWF [27] areas constitute a scarce comparative material for the assessment of taxonomic composition and consistency of occurrence of macrozoobenthos in the OWF Area. The comparison of the results from the macrozoobenthos surveys (Table 3.4) carried out on the soft bottom for a similar depth range (21–54 m) in the open water region of the Southern Baltic, as part of the three above-mentioned projects in 2013–2019, demonstrated that macrozoobenthos did not show any distinguishing characteristics in terms of composition and taxonomic diversity in any of the projects. The maximum number of macrozoobenthos taxa confirmed in the Baltic Power OWF Area was slightly lower than in the neighbouring regions of the project.

Table 3.4. Characteristics of the macrozoobenthos surveys on the soft bottom in the OWF Area (1 NM) in 2019 compared with the results of the macrozoobenthos surveys in the Bałtyk III OWF and Bałtyk II OWF Areas in 2013 and 2014 as well as the Baltica OWF Area in 2016 [Source: Baltic Power Sp. z o.o. data]

Parameter	Bałtyk III OWF Area (2013)	Bałtyk II OWF Area (2013, 2014)	Baltica OWF Area (2016)	Baltic Power OWF Area (1 NM) (2019)
Number of stations	175	117	402	200
Depth range [m]	26–42	23–44	21–54	28–45
Number of taxa: max., range	27; 4–16	32; 3–12	33; 4–18	25; 4–15
Most often recorded taxa	*Pygospio elegans*, *Marenzelleria* sp., *Limecola balthica*, *Hediste diversicolor*	*Pygospio elegans*, *Marenzelleria* sp.	*Marenzelleria* sp., *Pygospio elegans*, *Limecola balthica*, *Bylgides sarsi*, *Diastylis rathkei*	*Marenzelleria* sp., *Pygospio elegans*, *Limecola balthica*, *Bylgides sarsi*, *Monoporeia affinis*

Multimetric index B was used to assess the quality status of macrozoobenthos communities on the soft bottom, while the TSP index was used for the hard bottom (Appendix 1 to the EIA Report).

The largest part of the planned OWF Area (1 NM) is covered by a sandy seabed characterised by the values of the macrozoobenthos inhabiting it, determined as moderate. Whereas, the status of the macrozoobenthos communities within the seabed sections covered with stones (up to 5% of the seabed surface in the survey area), confirmed in the southern and north-eastern part of the OWF Area (1 NM), is specified as good or even very good (Figure 3.5).

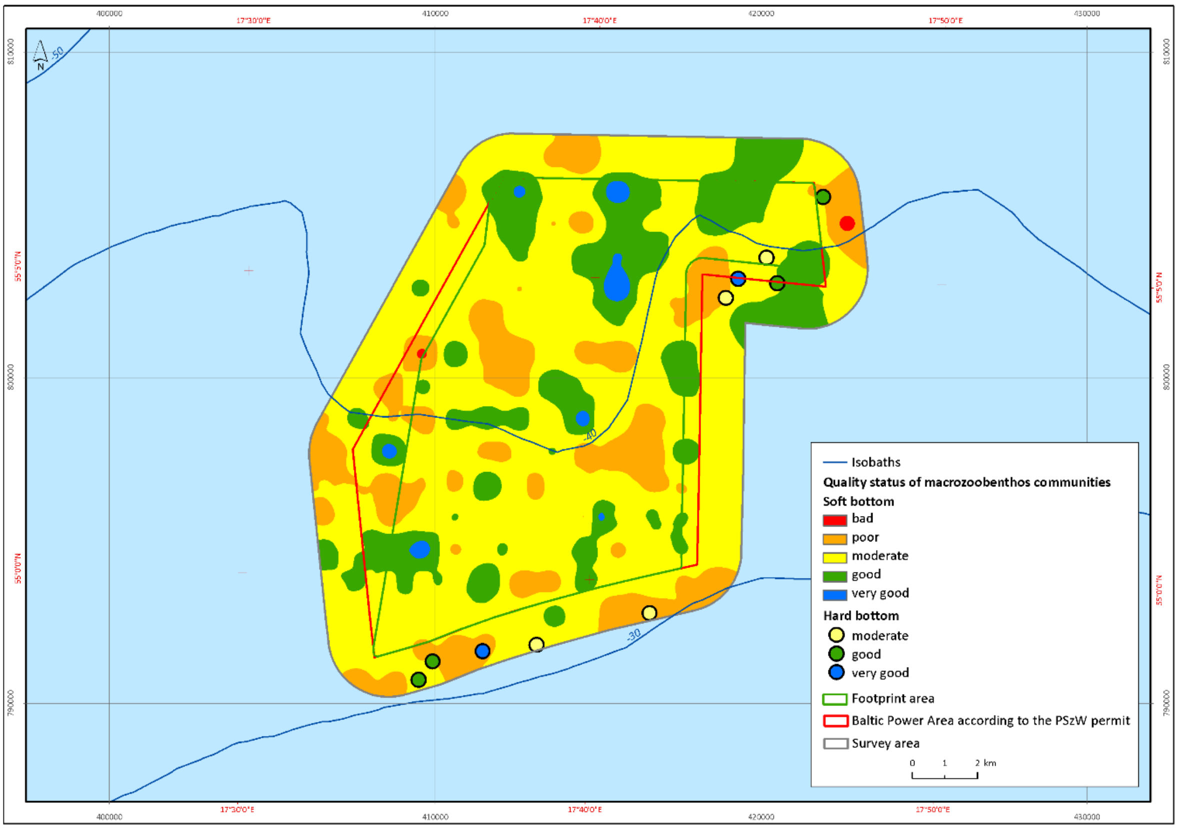


Figure 3.5. Spatial distribution of the macrozoobenthos community quality status within the OWF Area (1 NM) [Source: Baltic Power Sp. z o.o. data]

3.7.1.3 Ichthyofauna

The ichthyofauna surveys were conducted in the OWF Area to determine the species composition, abundance and distribution of ichthyofauna, the structure and biological characteristics of the species of fish occurring there, including also the species composition and abundance of ichthyoplankton.

The ichthyofauna surveys were conducted in a one-year-long cycle including 4 survey campaigns covering all seasons of the year.

Apart from herring and sprat, also few specimens of garfish, three-spined stickleback, great sand eel, anchovy (*Egraulis encrasicolus*), flounder and lumpfish (*Cyclopterus lumpus*) were caught in the course of pelagic control hauls aimed at investigating the proportions of individual species share for the purposes of estimating pelagic fish biomass.

The result of demersal catches conducted in the OWF Area using bottom-set nets is 1351.39 kg of fish belonging to 13 taxa. The flounder and cod dominated, whereas other species were a small by-catch (great sand eel, plaice, shorthorn sculprin, pogge, fourbeard rockling, turbot, herring, viviparous eelpout, whiting, common dab).

Fish belonging to 22 taxa were caught into all survey gear within the OWF Area (Table 3.5). Permanent fish communities included cod, flounder, plaice, turbot, herring, sprat and sparsely occurring shorthorn sculpins, lumpfish, great sand eels and viviparous eelpout (*Zoarces viviparus*). The presence of larvae of such species as gobies, fourbeard rockling, rock gunnel (*Pholis gunnellus*), longspined bullhead or common seasnail does not prove that the area is inhabited by the adult fish.

Table 3.5. Specification of all the taxa recorded in the course of survey catches in the Baltic Power OWF Area

Species/genus	Type of catches		
	Pelagic of ichthyofauna	**Bottom of ichthyofauna**	**Ichthyoplankton**
Cod *Gadus morhua*		X	
Flounder *Platichthys flesus*	X	X	X
European plaice *Pleuronectes platessa*		X	X
Turbot *Scophthalmus maximus*		X	
Herring *Clupea harengus*	X	X	X
European sprat *Sprattus sprattus*	X		X
Great sand eal *Hyperoplus lanceolatus*	X	X	X
Lesser sand eal *Ammodytes tobianus*	X		X
Shorthorn sculpin *Myoxocephalus scorpius*		X	X
Lumpfish *Cyclopterus lumpus*	X	X	
Viviparous eelpout *Zoarces viviparus*		X	
Fourbeard rockling *Enchelyopus cimbrius*		X	X
Whiting *Merlangius merlangus*		X	
Common dab *Limanda limanda*		X	
Pogge *Agonus cataphractus*		X	
Garfish *Belone belone*	X		
Three-spined stickleback *Gasterosteus aculeatus*	X		
European anchovy *Engraulis encrasicolus*	X		
Gobies *Gobiidae*			X
Longspined bullhead *Taurulus bubalis*			X
Rock gunnel *Pholis gunnellus*			X
Common sea snail *Liparis liparis*			X

The OWF Area is relatively poor in terms of species diversity, with a distinct prevalence of cod and flounder in demersal catches and herring and sprat in pelagic catches.

The survey area was not recognised to be a significant breeding area. Only in summer, it was found to be a non-significant breeding area for sprat. For herring, the survey results obtained indicate that during the survey period the area of the planned project provided habitat for **herrings** and the area was crossed by migration routes towards wintering as well as spawning (probably) and feeding grounds.

The survey results prove that the area of the planned project was the place of **sprat** occurrence and migration in each of the four seasons of 2019. The area surveyed was identified as the area of seasonal occurrence and migration of part of the sprat adult population, which participated in spawning from January to July, which proves that this process in 2019 was considerably extended in time in comparison to the previous years. Between summer and autumn, when the sprat spawning was completed, mass feeding and migration of fish to feeding grounds occurred, also within the area of the planned project.

The sea area of the planned project is characterised by the prevalence of juvenile **cod** throughout the year, with a possible periodic increase in the proportion of cod of older age groups, resulting from the breeding and feeding migrations. A significant proportion of juvenile cod in the region monitored, as is the case with the prevalence of smaller size cod in the catches, may result from the current status of cod stocks, which due to a significant fishing and natural mortality, affecting mostly larger (and older) cod, is characterised by the prevalence of the cod of younger age group [190]. The analysis of seasonal variations in the cod gonadal maturity in the OWF Area indicates that cod migrate across the OWF Area and that this sea area is not a breeding ground for cod. The results of the analysis of stomach fullness degree demonstrate that more favourable feeding conditions are in the survey area in winter, summer and autumn. The diversity of food components found in the cod stomachs suggests that the region of the planned project is favourable in terms of food composition for cods of different sizes.

The area of the planned project provides habitat for adult flounders. During the survey catches, no significant proportion of juvenile individuals was recorded there in any of the seasons. Migration routes of the flounders coming from the deep-water spawning grounds (e.g. the Słupsk Furrow) to the coastal feeding grounds may run through the area of the planned project.

The area analysed is not the flounder spawning ground due to its too low salinity. On the basis of the analysis of stomach fullness, it can be assumed that flounders have found appropriate conditions for feeding within the survey area.

Concluding, out of the 22 taxa observed during the ichthyofauna surveys carried out for the purpose of the planned project, four are of particular economic importance in terms of commercial fishing. These are: sprat (*S. sprattus*), herring (*C. harengus*), cod (*G. morhua)*, flounder (*P. flesus*). Salmon (*Salmo salar*) and sea trout (*Salmon trutta*) were not observed during the survey catches (no standardised survey methods, low density), however, these two species are found in commercial fishing.

In survey catches conducted in the Baltic Power OWF Area, the most numerous were: sprat, herring, cod and flounder, which form the basis of commercial fishing.

Additionally, in the course of the above-mentioned surveys, the occurrence of 438 goby larvae, which belong most probably to the partially protected species of the **sand goby** (*Pomatoschistus minutus*) and 87 larvae of the **common sea snail** (*L. liparis*), which is also under partial protection in Poland, were recorded in the ichthyoplankton samples.

To assess the significance of the Baltic Power OWF Area with respect to ichthyofauna, its following values were considered: taxonomic diversity, occurrence of protected and endangered as well as commercial species, feeding or spawning grounds, migration routes. On the basis of the above-mentioned functions, the natural values of this area were assessed as moderate. This evaluation was made on the basis of an expert assessment.

3.7.1.4 Marine mammals

Taking into consideration the specificity of the marine mammal occurrence in the Southern Baltic, three species of marine mammals may occur in the Baltic Power OWF Area: the harbour porpoise (*Phocoena phocoena*), the grey seal (*Halichoerus grypus*) and the harbour seal (*Phoca vitulina*). Moreover, there is a low probability of the ringed seal occurrence (*Pusa hispida*).

The harbour porpoise (*Phocoena phocoena*) is the only representative of cetaceans in the Baltic Sea. According to the data from the SAMBAH project conducted in the years 2011–2013, the Polish Maritime Areas belong to the areas with low harbour porpoise detection level, indicating a low density of this species therein (Figure 3.6). The abundance of this species in the Baltic Proper area was estimated at a level of 80 to 1091 individuals (497 on average) [364]. Currently, the accurate status of the harbour porpoise population in the Polish part of the Baltic Sea is uncertain, however, its abundance is determined as very low [155, 227, 375].

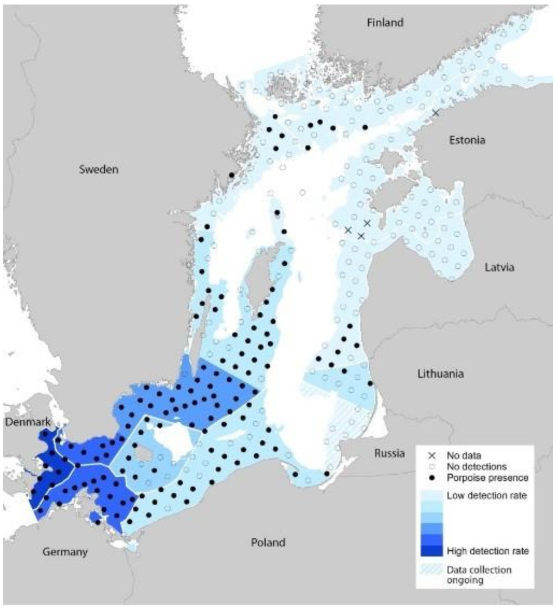


Figure 3.6. The SAMBAH project results presenting the distribution of the harbour porpoise detection rate in the Baltic Sea [412]

The latest surveys conducted at the request of the Chief Inspectorate for Environmental Protection, as part of the project entitled “Pilot implementation of species and marine habitats monitoring in 2015–2018” in the area of the Pomeranian Bay and the Słupsk Bank have demonstrated a higher harbour porpoise detection rate in comparison to the results of the SAMBAH project from the years 2011–2013 in the two areas surveyed. Within the Pomeranian Bay, the average values of detection positive days expressed as a percentage (%DPD) was recorded at a level of 4.56 %DPD, which was a higher value in reference to the results of the SAMBAH project, for which a value of 0.43 %DPD was recorded in that area. In the case of the Stilo Bank, higher values were also recorded during the pilot project monitoring, in which the average value was 0.32 %DPD, while in the SAMBAH project, a 0.08 %DPD was recorded. Despite higher harbour porpoise detection rates in the Polish waters in the period from 2016 to 2018, the number of detections was still relatively low. The analyses of the data collected indicated differences in the occurrence of the harbour porpoise in the two areas surveyed. Moreover, differences in the seasonality of its occurrence were indicated, while the highest DPD values in the Pomeranian Bay were recorded in summer, in the area of the Stilo Bank the highest values were recorded in spring [261].

The monitoring conducted as part of the cooperation between WWF Poland and the Hel Marine Station IO UG during the implementation of the projects “Support for the restitution and protection of Baltic mammals in Poland” and “Protection of marine mammal and seabird habitats” indicated that in the years 2009–2019, 70 dead individuals of the harbour porpoise were found on the Polish Coast, while, one observation (in 2010) was made within 30 km from the Baltic Power OWF Area [468].

During the surveys carried out between December 2018 and January 2020 for the purposes of the EIA Report for the Baltic Power OWF, passive acoustic monitoring of the harbour porpoise in the OWF Area (2 NM) was conducted using C-PODs and through aerial observations. In the survey area, five main and two additional acoustic devices were located, which were continuously detecting the sounds emitted by the harbour porpoise. The data analysed indicated that the average %DPD value from all stations was 0.62. The highest values of detection positive days were recorded at the CPOD_01 station in autumn.

The highest value of the harbour porpoise detection positive minutes (DPM) within a day was recorded at the CPOD_01 station on 13 September 2019, when it equalled 12 DPM, reaching the value of 0.83 %DPM (Figure 3.7). The number of porpoise clicks recorded was low.

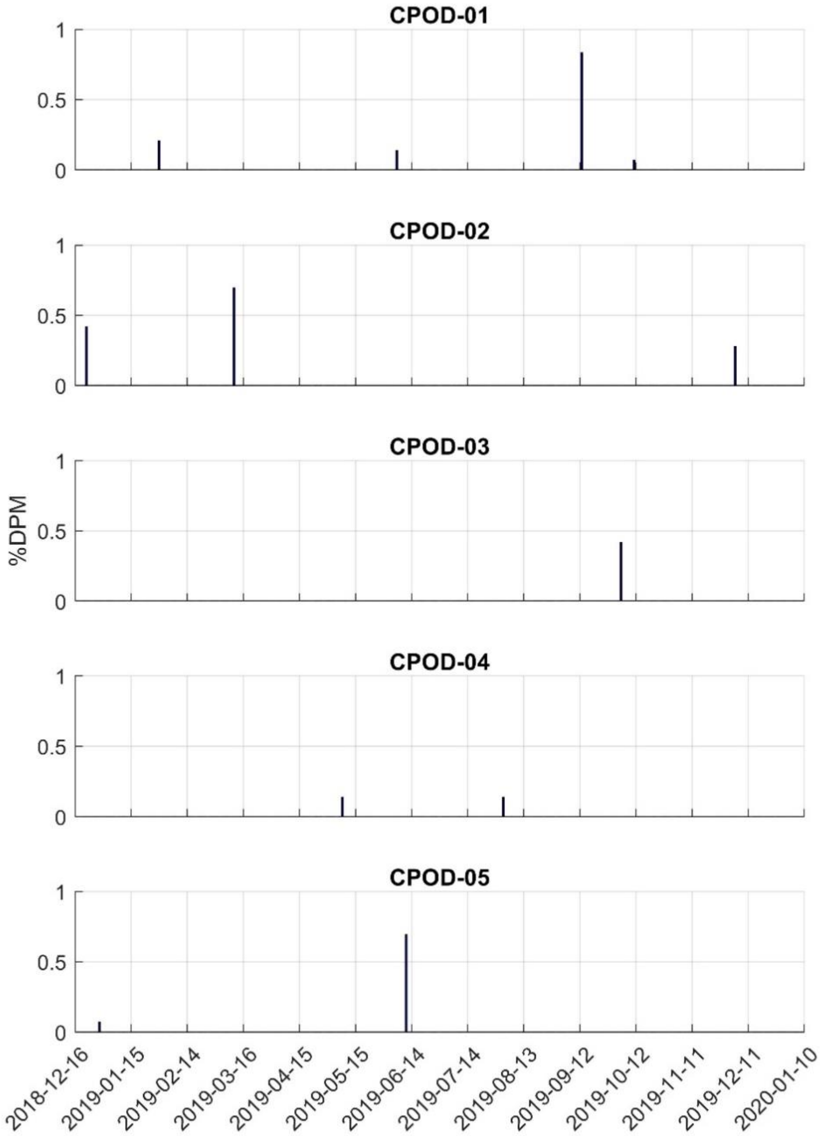


Figure 3.7. Harbour porpoise daily activity at five survey stations in the Baltic Power OWF Area (2NM). The activity is expressed as a percentage of detection positive minutes (%DPM) [Source: Baltic Power Sp. z o.o. data]

During the monitoring, the highest harbour porpoise %DPM was recorded at the CPOD_02 station (0.0034 %DPM), and second highest at the CPOD_01 station (0.0033 %DPM) (Figure 3.8). Autumn was characterised by the highest %DPM (0.0029 %DPM) in comparison to the remaining seasons (Figure 3.9).

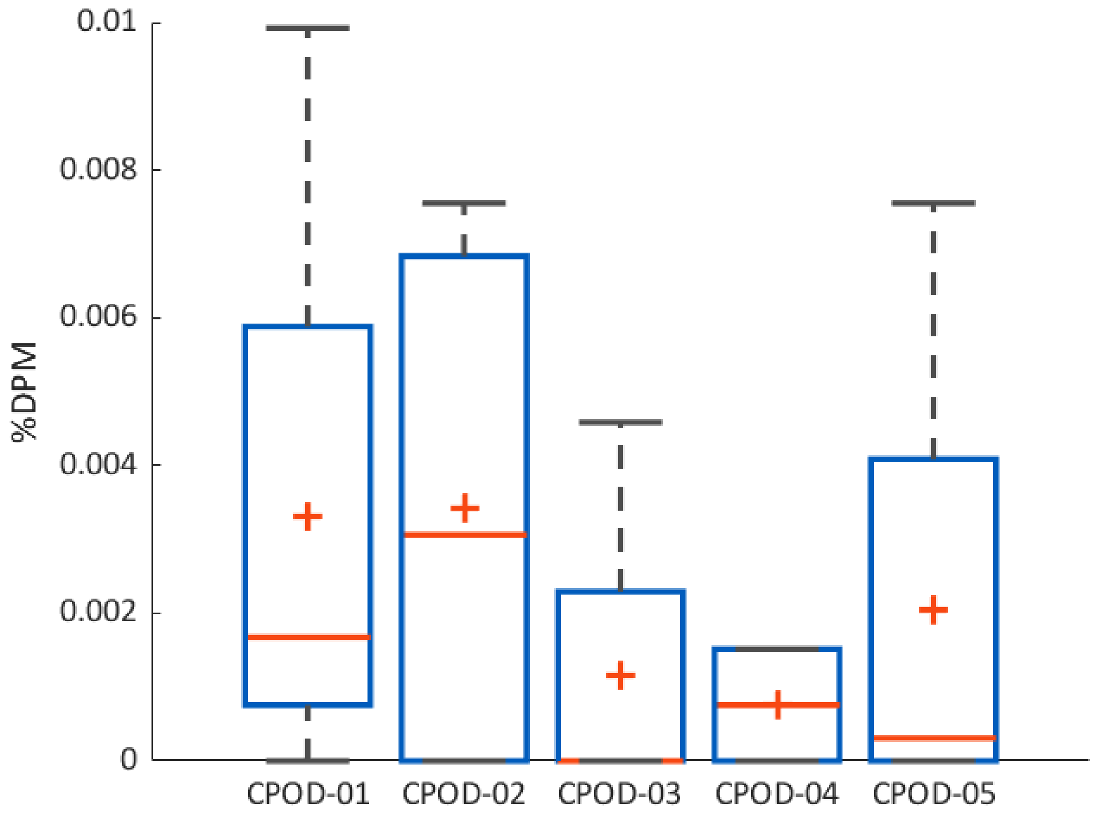


Figure 3.8. *Activity of porpoises (%DPM) at every survey station, within the entire monitoring period. The red cross represents the mean, the red horizontal line represents the median (the 50th percentile), the lower edge of the box represents the lower quartile (the 25th percentile), the upper edge of the box represents the upper quartile (the 75th percentile), the whiskers represent the maximum and minimum value [Source: Baltic Power Sp. z o.o. data]*

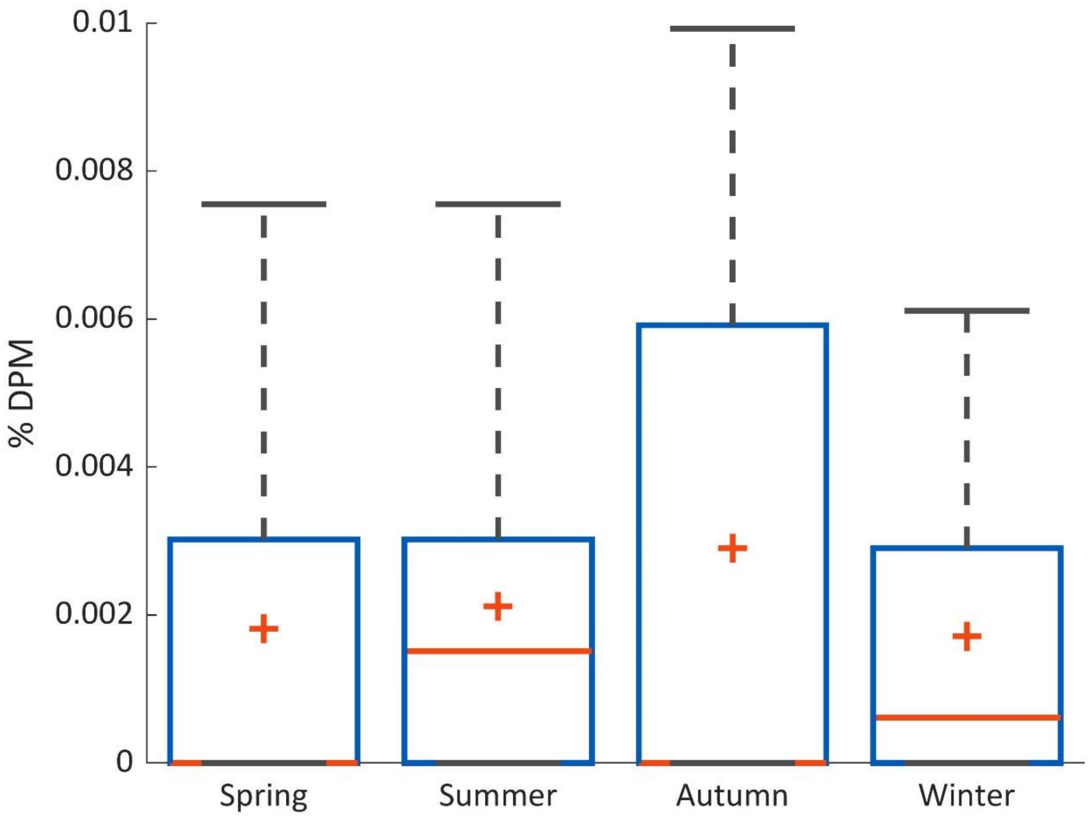


Figure 3.9. Activity of porpoises (%DPM) in spring (March–May), summer (June–August), autumn (September–November) and winter (December–February) in the entire Baltic Power OWF Area. The red cross represents the mean, the red horizontal line represents the median (the 50th percentile), the lower edge of the box represents the lower quartile (the 25th percentile), the upper edge of the box represents the upper quartile (the 75th percentile), the whiskers represent the maximum and minimum value [Source: Baltic Power Sp. z o.o. data]

During one of the observation flights conducted in the spring-summer period, a marine mammal individual, unidentified as to the species, was observed. Apart from that, no other observations of marine mammals were made in the survey area.

The results of the harbour porpoise acoustic monitoring and aerial observations conducted in the Baltic Power OWF Area (2NM) confirm a low occurrence of this species in the location surveyed. The harbour porpoise detections in the survey area during the entire monitoring period were occasional.

There are three species of **seals** occurring in the Baltic Sea. The number of the Baltic grey seal has exceeded 32 000 individuals [178]. The subpopulation of the Baltic harbour seal is estimated at 1563 individuals [NOVANA census, Jonas Teilmann – personal communication], while that of the ringed seal at 10 000 individuals [178]. According to HELCOM, the grey seal regularly occurs in the Polish part of the Baltic Sea, the harbour seal occurs in its western part, while the ringed seal may be observed in the northern part of the Polish waters [177].

According to the results of seal observations in the Polish area of the Baltic Sea from the last 10 years, coming from the WWF databases and the Hel Marine Station IO UG, among all of the species identified, the grey seal has been the most often observed seal in the survey area (65% of observations), next was the harbour seal (5% of observations) and the ringed seal (0.6% of observations) (Figure 3.10).

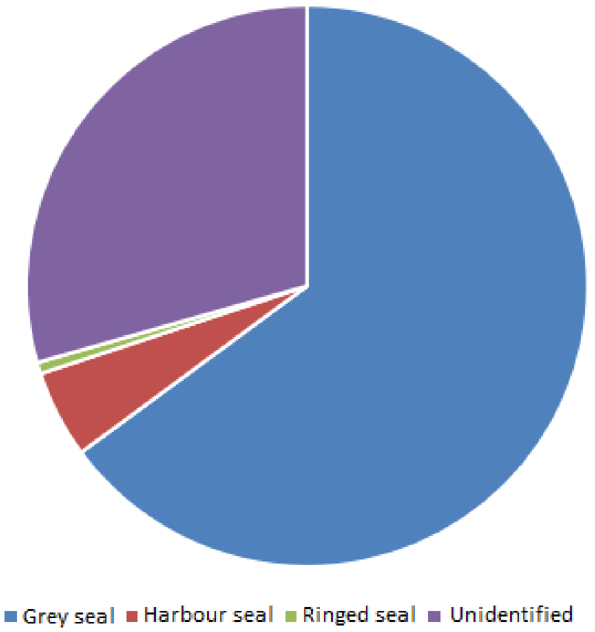


Figure 3.10. Division of the results of seal observations at the Polish coast, obtained in the period from 1 January 2009 to 3 December 2019, on the basis of the database maintained by WWF Poland and the Hel Marine Station IO UG as part of the project "Support for the restitution and protection of Baltic mammals in Poland" and "Protection of marine mammal and seabird habitats" [468] [Source: internal materials]

The highest number of grey seals is recorded in the vicinity of the Vistula Cut estuary, in the Mewia Łacha Nature Reserve. Currently, this reserve is a permanent habitat for the grey seal, in which the species finds good conditions for rest. There are from several up to 300 individuals (usually several dozens) present in this region daily [353].

The data collected in the years 2016–2018 as part of the "Pilot implementation of species and marine habitats monitoring in 2015–2018" confirmed the presence of a haul-out in the area of the Vistula Cut estuary. In the period discussed, the number of grey seals equalled about 200 individuals during the moulting period [262]. During observations, only a single individual of the harbour seal was recorded at a haul-out [263].

In the years 2009–2019, the WWF Poland Blue Patrol recorded 106 observations of grey seals, 1 observation of harbour seal and 2 observations of ringed seals along the coast situated approx. 30 km away from the Baltic Power OWF Area (Table 3.6).

Table 3.6. Results of seal observations at the Polish coast in the area approx. 30 km away from the Baltic Power OWF, obtained in the period from 1 January 2009 to 3 December 2019 on the basis of the database maintained by WWF Poland and the Hel Marine Station IO UG as part of the project "Support for the restitution and protection of Baltic mammals in Poland" and "Protection of marine mammal and seabird habitats" [468] {Source: internal materials]

Species	Number of live individuals	Number of dead individuals	In total
Grey seal	33	73	106
Harbour seal	1	0	1
Ringed seal	2	0	2
Unidentified	11	8	19

In the period from 16 December 2018 to 3 December 2019, the WWF Poland Blue Patrol conducted observations of 4 live and 7 dead grey seal individuals, in the area situated approx. 30 km away from the area of the planned Baltic Power OWF. Moreover, data in the form of GPS routes obtained from the transmitters of grey seals marked and released by the employees of the Hel Marine Station IO UG, show those mammals pass through the area of the planned Baltic Power OWF (Figure 3.11).

Figure 3.11. Movement routes of grey seals released by the Hel Marine Station IO UG in the period from December 2018 to December 2019 [410]

In the period from December 2018 to January 2020, as part of the environmental monitoring in the Baltic Power OWF Area (2NM) four observation flights were conducted. During one of the observation flights conducted in the spring-summer period, a single marine mammal individual, unidentified as to the species, was observed. Apart from that, no other observations of marine mammals were made in the survey area.

Marine mammal surveys were carried out also as part of seabird observations, in the period from October 2018 to November 2019, along the designated transects situated in the Baltic Power OWF Area. During the above-mentioned surveys, 3 individuals were observed: one observation of a seal unidentified as to the species, and two observations of the grey seal.

The results of the harbour porpoise acoustic monitoring, aerial visual observations and additional observations of marine mammals from aboard survey vessels conducted as part of the seabird surveys, confirm a low occurrence of harbour porpoises and seals in the area surveyed, which is compliant with the general conclusions obtained from the SAMBAH project and the project entitled "Pilot implementation of species and marine habitats monitoring in 2015–2018".

3.7.1.5 Migratory birds

The Baltic Sea waters along the Polish coast and in the area, in which the planned Baltic Power OWF is situated, constitute part of the migratory bird route between the breeding grounds in northern and eastern Europe and the north-western Asia [27, 331, 379]. The migration characteristics (flight altitude and direction, type of flight, flight during the day, at night) are specific to particular groups of species. For example, sea ducks and auks fly low above the surface of water (more than 90% of the auks, common scoters and long-tailed ducks observed flew at a hight of up to 20 m a.s.l.). The flight characteristics depend also on the weather conditions, wind direction and visibility [5].

The Table (Table 3.8) presents the migratory bird species observed during surveys (categories identified only up to the order or family are included in Appendix 1 to the EIA Report), including their protection status and the total abundance of individuals observed during surveys.

Table 3.7. Number of bird individuals identified up to the species (the remaining categories in Appendix 1 to the EIA Report), recorded in the survey period and their national and international protection status [Source: Baltic Power Sp. z o.o. data]

No.	**Species**	**Number of individuals**	**Species protection in Poland[1]**	**Annex I of the EU Birds Directive**	**IUCN[2]**	**HELCOM[3]**
1.	Common scoter *Melanitta nigra*	1711	P	Not	LC	-
2.	Long-tailed duck *Clangula hyemalis*	1418	P	Not	**VU**	**-**
3.	Eurasian skylark *Alauda arvensis*	384	P	Not	LC	-
4.	Common wood pigeon *Columba palumbus*	355	G	Not	LC	-
5.	Velvet scoter *Melanitta fusca*	312	P	Not	**VU**	**VU**
6.	Eurasian wigeon *Mareca penelope*	303	P	Not	LC	-
7.	Common chaffinch *Fringilla coelebs*	303	P	Not	LC	-
8.	Little gull *Hydrocoloeus minutus*	246	P	**Yes**	NT	-
9.	Greater white-fronted goose *Anser albifrons*	188	G	Not	LC	-
10.	Greater scaup *Aythya marila*	184	P	Not	**VU**	**VU**
11.	Razorbill *Alca torda*	181	P	Not	NT	-
12.	Common gull *Larus canus*	164	P	Not	LC	-
13.	Great black cormorant *Phalacrocorax carbo*	129	PP	Not	LC	-
14.	Eurasian siskin *Carduelis spinus*	123	P	Not	LC	-
15.	Northern shoveler *Spatula clypeata*	122	P	Not	LC	-
16.	Common starling *Sturnus vulgaris*	120	P	Not	LC	-
17.	Lesser black-backed gull *Larus fuscus*	110	P	Not	LC	**VU**
18.	Common teal *Anas crecca*	83	G	Not	LC	-

No.	Species	Number of individuals	Species protection in Poland[1]	Annex I of the EU Birds Directive	IUCN[2]	HELCOM[3]
19.	Eurasian curlew *Numenius arquata*	83	P	Not	**VU**	**-**
20.	Bean goose *Anser fabalis*	82	G	Not	LC	-
21.	Common murre *Uria aalge*	81	P	Not	NT	-
22.	Mallard *Anas platyrhynchos*	51	G	Not	LC	-
23.	Common crane *Grus grus*	41	P	**Yes**	LC	-
24.	Northert pintail *Anas acuta*	40	P	Not	LC	-
25.	White wagtail *Motacilla alba*	32	P	Not	LC	-
26.	Brambling *Fringilla montifringilla*	27	P	Not	LC	-
27.	Black-throated diver *Gavia arctica*	25	P	**Yes**	LC	-
28.	Red-throated diver *Gavia stellata*	24	P	**Yes**	LC	-
29.	Black-headed gull *Larus ridibundus*	21	P	Not	LC	-
30.	Barn swallow *Hirundo rustica*	20	P	Not	LC	-
31.	Whooper swan *Cygnus cygnus*	20	P	**Yes**	LC	-
32.	Jackdaw *Corvus monedula*	18	P	Not	LC	-
33.	Red-breasted merganser *Mergus serrator*	16	P	Not	NT	**VU**
34.	Common swift *Apus apus*	15	P	Not	LC	-
35.	Rook *Corvus frugilegus*	13	P	Not	LC	-
36.	Greylag goose *Anser anser*	12	G	Not	LC	-
37.	Grey heron *Ardea cinerea*	11	PP	Not	LC	-
38.	Mute swan *Cygnus olor*	10	P	Not	LC	-
39.	Meadow pipit *Anthus pratensis*	10	P	Not	NT	-
40.	Great black-backed gull *Larus marinus*	9	P	Not	LC	-
41.	European golden plover *Pluvialis apricaria*	9	P	**Yes**	LC	-

No.	Species	Number of individuals	Species protection in Poland[1]	Annex I of the EU Birds Directive	IUCN[2]	HELCOM[3]
42.	Common snipe *Gallinago gallinago*	8	P	Not	LC	-
43.	Western yellow wagtail *Motacilla flava*	8	P	Not	LC	-
44.	Barnacle goose *Branta leucopsis*	8	P	**Yes**	LC	-
45.	Tufted duck *Aythya fuligula*	7	G	Not	LC	NT
46.	Common linnet *Carduelis cannabina*	7	P	Not	LC	-
47.	Goosander *Mergus merganser*	7	P	Not	LC	-
48.	Sand martin *Riparia riparia*	7	P	Not	LC	-
49.	Eurasian sparrowhawk *Accipiter nisus*	6	P	Not	LC	-
50.	Great egret *Ardea alba*	6	P	**Yes**	LC	-
51.	Eurasian wren *Troglodytes troglodytes*	5	P	Not	LC	-
52.	Caspian gull *Larus cachinnans*	4	PP	Not	LC	-
53.	Black tern *Chlidonias niger*	4	P	**Yes**	LC	-
54.	Osprey *Pandion haliaetus*	4	P	**Yes**	LC	-
55.	Common goldeneye *Bucephala clangula*	3	P	Not	LC	-
56.	Great crested grebe *Podiceps cristatus*	3	P	Not	LC	-
57.	Pomarine skua *Stercorarius pomarinus*	3	P	Not	LC	-
58.	Merlin *Falco columbarius*	3	P	**Yes**	LC	-
59.	Common redstart *Phoenicurus phoenicurus*	2	P	Not	LC	-
60.	Common house martin *Delichon urbicum*	2	P	Not	LC	-
61.	Common sandpiper *Actitis hypoleucos*	2	P	Not	LC	-
62.	Eurasian hobby *Falco subbuteo*	2	P	Not	LC	-
63.	European robin *Erithacus rubecula*	2	P	Not	LC	-
64.	Long-eared owl *Asio otus*	2	P	Not	LC	-

No.	Species	Number of individuals	Species protection in Poland[1]	Annex I of the EU Birds Directive	IUCN[2]	HELCOM[3]
65.	Mistle thrush *Turdus viscivorus*	2	P	Not	LC	-
66.	Parasitic jaeger *Stercorarius parasiticus*	2	P	Not	LC	-
67.	Song thrush *Turdus philomelos*	2	P	Not	LC	-
68.	Whimbrel *Numenius phaeopus*	2	P	Not	LC	-
69.	European honey buzzard *Pernis apivorus*	2	P	**Yes**	LC	-
70.	Western marsh harrier *Circus aeruginosus*	2	P	**Yes**	LC	-
71.	Hen harrier *Circus cyaneus*	2	P	**Yes**	NT	-
72.	Eurasian blue tit *Parus caeruleus*	1	P	Not	LC	-
73.	Bohemian waxwing *Bombycilla garrulus*	1	P	Not	LC	-
74.	Common redshank *Tringa totanus*	1	P	Not	LC	-
75.	Eurasian blackcap *Sylvia atricapilla*	1	P	Not	LC	-
76.	Lapland longspur *Calcarius lapponicus*	1	P	Not	LC	-
77.	Black guillemot *Cepphus grylle*	1	P	Not	LC	NT
78.	Common chiffchaff *Phylloscopus collybita*	1	P	Not	LC	-
79.	Common greenshank *Tringa nebularia*	1	P	Not	LC	-
80.	Common kestrel *Falco tinnunculus*	1	P	Not	LC	-
81.	European pied flycatcher *Ficedula hypoleuca*	1	P	Not	LC	-
82.	Fieldfare *Turdus pilaris*	1	P	Not	LC	-
83.	Gadwall *Anas strepera*	1	P	Not	LC	-
84.	Great tit *Parus major*	1	P	Not	LC	-
85.	Grey plover *Pluvialis squatarola*	1	P	Not	LC	-
86.	Lesser whitethroat *Sylvia curucca*	1	P	Not	LC	-
87.	Stock dove *Columba oenas*	1	P	Not	LC	-

No.	Species	Number of individuals	Species protection in Poland[1]	Annex I of the EU Birds Directive	IUCN[2]	HELCOM[3]
88.	Willow warbler *Phylloscopus trochilus*	1	P	Not	LC	-
89.	Arctic tern *Sterna paradisaea*	1	P	**Yes**	LC	-
90.	Common tern *Sterna hirundo*	1	P	**Yes**	LC	-
91.	Short-eared owl *Asio flammeus*	1	P	**Yes**	LC	-
92.	Redwing *Turdus iliacus*	1	P	Not	NT	-
93.	Common pochard *Aythya ferina*	1	G	Not	**VU**	-
94.	Great northern diver *Gavia immer*	1	P	**Yes**	**VU**	**-**
95.	Common eider *Somateria mollissima*	1	P	Not	**VU**	**VU**

[1]Species protection in Poland: P – protected species, G – game species, PP – partial protection
[2]IUCN Species status for Europe: LC – Least concern, VU – Vulnerable, NT – Near Threatened [34]
[3]HELCOM: VU – Vulnerable, NT – Near Threatened [180]

During spring surveys, the most numerous of the species observed (the sum of all individuals from all visual observations) were sea ducks: the common scoter and the long-tailed duck, followed by the little gull and the razorbill.

Among the most numerous categories of birds observed, unidentified as to the species, but identified to the order or family, were passerines (more than 5% of all spring and autumn observations) and geese, the mass flights of which were recorded in autumn. More than 9000 geese were observed then, between September and October, which is more than 69% of all observations made in autumn. In autumn, skylarks and chaffinches with the remaining passerines were observed more often than sea ducks.

Within the entire monitoring period, geese were observed in the highest numbers (this was influenced by the mass autumn observations in 2019), next were common scoters and long-tailed ducks. Less numerous, but still often observed species were also: the common wood pigeon, common guillemot, razorbill, Euroasian wigeon, greater scaup and the common gull (Table 3.7). The common crane was recorded only sporadically during observations, however, on the basis of the surveys conducted for other OWF in this region, it is known, that this species flies across this Baltic Sea area surveyed in autumn, with favourable wind conditions, to travel from the resting grounds in Sweden to northern Germany [379].

Passerines analysed as a single category include species presented in the table (Table 3.8), as well as the category of "unidentified passerines", in case the identification of the species of the flying individual was impossible. This category included also the observations of two species of pigeon and the common swift, due to a similar flight manner of these birds. Among the most numerous species were the skylark, common wood pigeon (technically, this species is not a passerine, but due to a similar migration phenology and behaviour, for the purposes of this study, pigeons have been included there), common chaffinch, Eurasian siskin and the common starling.

Table 3.8. List of species observed classified in this report as "passerines" [Source: Baltic Power Sp. z o.o. data]

No.	Species/category	Spring	Autumn	Total
1.	Unidentified passerine *Passeriformes indet.*	243	791	1034
2.	Eurasian skylark *Alauda arvensis*	3	381	384
3.	Common wood pigeon* *Columba palumbus*	4	351	355
4.	Common chaffinch *Fringilla coelebs*	26	277	303
5.	Eurasian siskin *Carduelis spinus*	41	82	123
6.	Common starling *Sturnus vulgaris*	43	77	120
7.	Unidentified species of the genus *Carduelis* *Carduelis indet.*	0	51	51
8.	White wagtail *Motacilla alba*	16	16	32
9.	Brambling *Fringilla montifringilla*	27	0	27
10.	Barn swallow *Hirundo rustica*	18	2	20
11.	Common swift* *Apus apus*	13	2	15
12.	Meadow pipit *Anthus pratensis*	7	3	10
13.	Western yellow wagtail *Motacilla flava*	5	3	8
14.	Common linnet *Carduelis cannabina*	7	0	7
15.	Sand martin *Riparia riparia*	5	2	7
16.	Unidentified species of the genus *Hirundo* *Hirundo* sp.	6	0	6
17.	Eurasian wren *Troglodytes troglodytes*	5	0	5
18.	Common house martin *Delichon urbicum*	2	0	2
19.	Common redstart *Phoenicurus phoenicurus*	2	0	2
20.	European robin *Erithacus rubecula*	2	0	2
21.	Mistle thrush *Turdus viscivorus*	2	0	2
22.	Song thrush *Turdus philomelos*	2	0	2
23.	Eurasian blue tit *Parus caeruleus*	1	0	1

No.	Species/category	Spring	Autumn	Total
24.	Bohemian waxwing *Bombycilla garrulus*	0	1	1
25.	Common chiffchaff *Phylloscopus collybita*	0	1	1
26.	Eurasian blackcap *Sylvia atricapilla*	0	1	1
27.	European pied flycatcher *Ficedula hypoleuca*	1	0	1
28.	Fieldfare *Turdus pilaris*	0	1	1
29.	Great tit *Parus major*	0	1	1
30.	Lapland longspur *Calcarius lapponicus*	0	1	1
31.	Lesser whitethroat *Sylvia curruca*	0	1	1
32.	Redwing *Turdus iliacus*	1	0	1
33.	Stock dove *Columba oenas*	1	0	1
34.	Unidentified thrush *Turdus indet.*	1	0	1
35.	Willow warbler *Phylloscopus trochilus*	0	1	1
Total		484	2046	2530

**Two species of pigeon and the common swift were included in the summary analysis of passerines, due to similar flight characteristics*

The analysis of migratory flux (the width of flight across the Baltic Power Area included in the analysis was 10 km) indicated that the long-tailed ducks flying during the spring migration accounted for 2%, while in autumn − for 0.97% of the biogeographical population of this species. For the common scoter, the results indicate 9.88% of the biogeographical population in spring and 0.38% in autumn. Lower values were obtained for the velvet scoter: 0.6% in spring and 1.11% in autumn (population size based on Birdlife International [34]). Relatively greater flight fluxes were obtained for geese – up to 3% of the total population of all geese migrating across the Baltic Power Area is expected to fly across the Baltic Power Area in autumn. Estimates obtained for the spring migration of the little gull (10%) and the greater scaup (1.68%) are also high (Table 3.9).

Table 3.9. The proportion of populations of individual species flying across the Baltic Sea based on the flight fluxes of individual species migrating across the Baltic Power OWF Area in spring and autumn [Source: Baltic Power Sp. z o.o. data]

Taxon	Population size of migratory birds [34]	Migration season	Estimate of migration intensity [number of individuals]	Proportion of population of birds in flight [%]
Long-tailed duck *Clangula hyemalis*	1 600 000	Spring	33 023	2.06
		Autumn	15 493	0.97
	550 000	Spring	54 341	9.88

Taxon	**Population size of migratory birds [34]**	**Migration season**	**Estimate of migration intensity [number of individuals]**	**Proportion of population of birds in flight [%]**
Common scoter *Melanitta nigra*		Autumn	2101	0.38
Velvet scoter *Melanitta fusca*	450 000	Spring	2715	0.60
		Autumn	4987	1.11
Ducks (Eurasian wigeon, etc.) *Anatini*	>6 500 000	Spring	11 976	0.18
		Autumn	9488	0.15
Greater scaup *Aythya marila*	310 000	Spring	5216	1.68
		Autumn	268	0.09
Geese *Anseridae*	>3 500 000	Spring	73	0.00
		Autumn	103 427	2.96
Swans *Cygnus sp.*	300 000	Spring	457	0.15
		Autumn	1286	0.43
Divers *Gaviidae*	>400 000	Spring	3036	0.76
		Autumn	217	0.05
Auks *Alcidae*	>5 000 000	Spring	2967	0.06
		Autumn	7509	0.15
Great black cormorant *Phalacrocorax carbo*	515 000	Spring	892	0.17
		Autumn	1263	0.25
Little gull *Hydrocoloeus minutus*	>72 000	Spring	7430	10.32
		Autumn	198	0.27
Black-headed gull *Larus ridibundus*	>4 770 000	Spring	321	0.01
		Autumn	369	0.08
Lesser black-backed gull *Larus fuscus*	>1 200 000	Spring	1977	0.16
		Autumn	1139	0.09
Common gull *Larus canus*	1 200 000	Spring	3868	0.32
		Autumn	1322	0.11
Terns *Sternidae*	>1 800 000	Spring	385	0.02
		Autumn	99	0.01
Charadriiformes *Charadriiformes*	>1 600 000	Spring	429	0.03
		Autumn	1259	0.08
Common crane *Grus grus*	240 000	Spring	951	0.40
		Autumn	0	-
Passerines *Passeriformes*	100 000 000	Spring	7531	0.01
		Autumn	141 237	0.14

28 species were identified on the basis of acoustic recordings. Most of the calls identified belong to seagulls, about a fifth to passerines belonging to 22 species. Among the passerine species, those which migrate only at night to avoid predation were identified [the common blackbird (*Turdus merula*), the European robin (*Erithacus rubecula*), the redwing (*Turdus iliacus*), and the song thrush (*Turdus philomelos*)], as well as species more active during daylight hours [the common chaffinch (*Fringilla*

coelebs), the white wagtail (*Motacilla alba*), the western yellow wagtail (*Motacilla flava*), the meadow pipit (*Anthus pratensis*) and the goldfinch (*Carduelis carduelis*)] (Table 3.10).

Table 3.10. List of bird sounds recorded on acoustic recordings during surveys conducted in spring and autumn [Source: Baltic Power Sp. z o.o. data]

No.	Species/Category	Spring	Autumn	Total
1.	Unidentified gull *Laridae indet.*	4530	4339	8869
2.	European herring gull *Larus argentatus*	95	4465	4560
3.	Redwing *Turdus iliacus*	330	847	1177
4.	Common blackbird *Turdus merula*	98	798	896
5.	European robin *Erithacus rubecula*	293	123	416
6.	Song thrush *Turdus philomelos*	92	254	346
7.	Greater white-fronted goose *Anser albifrons*	0	160	160
8.	Common chaffinch *Fringilla coelebs*	80	10	90
9.	Great tit *Parus major*	0	87	87
10.	White wagtail *Motacilla alba*	48	31	79
11.	Unidentified passerine *Passeriformes indet.*	25	33	58
12.	Fieldfare *Turdus pilaris*	0	51	51
13.	Western yellow wagtail *Motacilla flava*	22	23	45
14.	Goldcrest *Regulus regulus*	6	37	43
15.	Meadow pipit *Anthus pratensis*	17	9	26
16.	Common gull *Larus canus*	18	3	21
17.	Common chiffchaff *Phylloscopus collybita*	11	3	14
18.	Goldfinch *Carduelis carduelis*	12	0	12
19.	Spotted flycatcher *Muscicapa striata*	9	1	10
20.	Eurasian blue tit *Parus caeruleus*	8	0	8
21.	Eurasian siskin *Carduelis spinus*	8	0	8
22.	Tree pipit *Anthus trivialis*	5	2	7
23.	Mistle thrush *Turdus viscivorus*	5	0	5
24.	Snow bunting *Plectrophenax nivalis*	0	4	4
25.	Wood sandpiper *Tringa glareola*	0	3	3

No.	Species/Category	Spring	Autumn	Total
26.	Lesser black-backed gull *Larus fuscus*	0	2	2
27.	Brambling *Fringilla montifringilla*	0	1	1
28.	Eurasian curlew *Numenius arquata*	1	0	1
29.	Eurasian skylark *Alauda arvensis*	0	1	1
30.	Greenfinch *Chloris chloris*	1	0	1
31.	Unidentified bird	1	0	1
Total		5715	11 287	17 002

The analysis of the results obtained using a vertical radar provided information on the migratory bird flight altitudes throughout a day. At the beginning of the spring migration, the highest migration intensity was recorded at an altitude of 0–100 m, both at night and during the day, with few recorded echoes at altitudes exceeding 1000 m. Nocturnal migration peaked in April, and bird echoes were read evenly at altitudes between 250 and 1500 m. However, still a significant majority of echoes was recorded at lower altitudes (0–250 m), both during the day and at night. In April, nocturnal migration was the most intense, which means that it was a period of mass migration of passerines. In May, nocturnal migration was still quite noticeable (at altitudes of 250–1500 m), however, most echoes were read for daytime hours at altitudes of 0–250 m. During the survey campaign in August, the intensity of migration was higher at night than during the day. Intense flights were recorded at altitudes above 1000 m, which probably reflects the flights of passerines migrating over long distances (crossing the Equator e.g. birds from the Acrocephalidae family). Nocturnal migration in September was most likely also dominated by passerines, while diurnal migration was characterised by a wide range of species, with the common scoter and passerines being the dominant species (conclusions made on the basis of visual observations and the data from the vertical radar).

Among the most commonly observed groups, as well as for the most important species of sea ducks, the distribution of fight altitudes was presented separately for spring and autumn, due to large differences in proportions and abundances in both seasons. The observations conducted demonstrate that the vast majority of the bird groups and species analysed flew at altitudes of up to 20 m a.s.l. (Figure 3.12, Figure 3.13). It should be remembered that the flight altitudes obtained from visual observations represent only a part of all flying birds and these values should be regarded as supporting information. Visual observations are intended to identify as many birds as possible, but due to the nature of this type of monitoring, birds flying low are much more frequently recorded than birds flying at altitudes above 100 m a.s.l. In autumn, the observations were dominated by geese flying at various altitudes up to 450 m (the maximum value recorded during visual observations). The auxiliary nature of these flight altitude observations should be emphasised, as they are vitiated with an error due to limited possibilities of bird detection at high altitudes, in favour of birds flying lower and closer to the observers at the survey station.

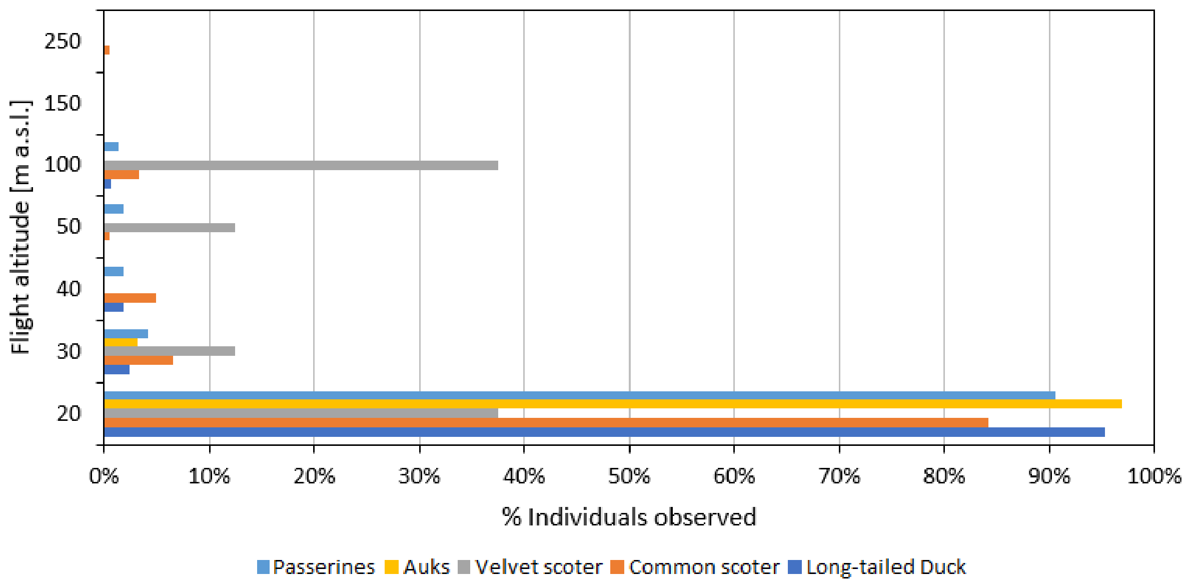


Figure 3.12. Flight altitudes of species observed at the shortest distance from the water table during spring migration (March – April 2019) [Source: Baltic Power Sp. z o.o. data]

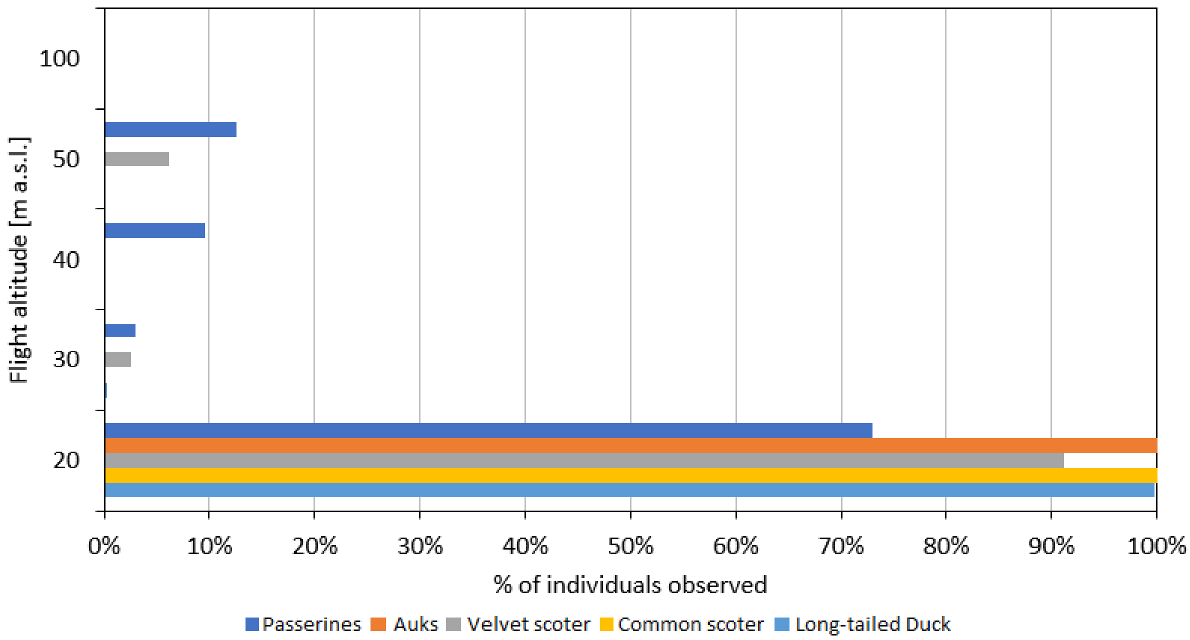


Figure 3.13. Flight altitudes of species observed at the shortest distance from the water table during autumn migration (August – November 2019) [Source: Baltic Power Sp. z o.o. data]

An analysis of all flights tracked in spring indicates a uniform north-eastern flight direction, towards the breeding grounds (Figure 3.14). This direction is recognisable for sea ducks, other duck species, passerines, divers and birds of prey. South-western direction prevailed in autumn (Figure 3.15). Among the flight paths identified, there were individual ones that indicated completely opposite directions (north-eastern, e.g., a single mallard individual). These isolated cases are probably local birds which spend the whole year in the region surveyed, or migratory birds (some auks) that had already completed their autumn migration and were recorded during short local feeding flights.

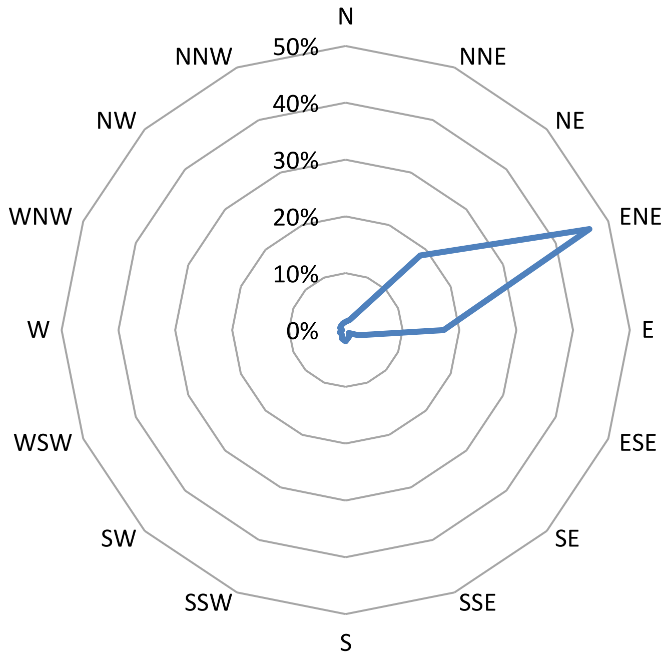


Figure 3.14. Flight directions of all bird species during spring migration (March–May 2019) [Source: Baltic Power Sp. z o.o. data]

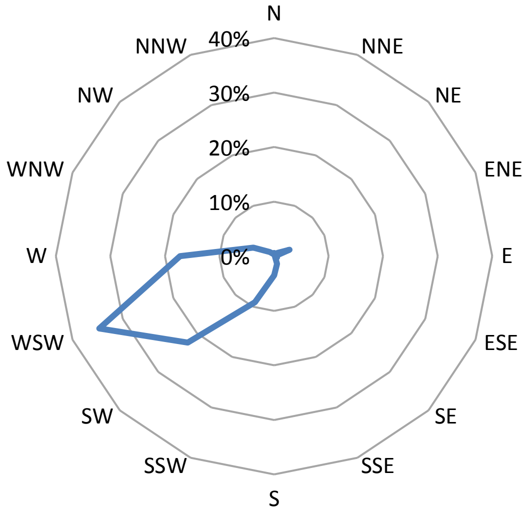


Figure 3.15. Flight directions of all bird species during autumn migration (August–November 2019) [Source: Baltic Power Sp. z o.o. data]

Of all of the species and categories recorded during surveys conducted in spring and autumn, 18 most commonly observed species (groups of species) were selected for further analysis for the purposes of this report. Their estimations concerning the share of biogeographical population flying across the area surveyed, as well as their significance based on the EIA methodology are presented in the table (Table 3.11). Among all the species recorded during the surveys, seven are considered endangered on a European scale (according to the international scale of the IUCN [34, 127]: the long-tailed duck, the velvet scoter, the Eurasian curlew, the common pochard, the common eider, the greater scaup and the great northern diver), however, only the long-tailed duck was observed in large numbers compared to its population. Seven species belong to the “near threatened” category: the little gull, the razorbill, the common guillemot, the red-breasted merganser, the redwing, the meadow pipit and the hen harrier, and none of these species were observed in large numbers. The observations of migratory birds conducted in autumn 2019 in Bornholm, show that the number of cranes migrating across the Słupsk Bank from Sweden is strongly dependent on the direction of wind. With the prevailing east winds, only few cranes decide to fly across this area (DHI own data). Because the abundances of geese and cranes flying across the survey area show great variability between subsequent years, in this report their classification was based (apart from the data collected for the purposes of this project) on the available inventory data from the following OWF projects: Bałtyk II, Bałtyk III, Baltica 2, Baltica 3, B-Wind and C-Wind [382, 383, 27].

Table 3.11. Species and groups of species included in the analyses for the purposes of this report with the assessment of the significance of a vulnerable population [Source: Baltic Power Sp. z o.o. data]

Taxon/category	**Population of migratory birds**	**Migration season**	**Proportion of population of birds in flight [%]**	**Significance of vulnerable population**	**Size of vulnerable population**	**Receptor value/significance**
Long-tailed duck *Clangula hyemalis*	1 600 000	Spring	2.06	Moderate	Local	High
		Autumn	0.97	Irrelevant	Irrelevant	
Common scoter *Melanitta nigra*	550 000	Spring	9.88	Significant	Regional	High
		Autumn	0.38	Irrelevant	Irrelevant	
Velvet scoter *Melanitta fusca*	450 000	Spring	0.6	Irrelevant	Irrelevant	High
		Autumn	1.11	Moderate	Local	
Ducks (Eurasian wigeon, etc.) *Anatini*	>6 500 000	Spring	0.18	Irrelevant	Irrelevant	Low
		Autumn	0.15	Irrelevant	Irrelevant	
Greater scaup *Aythya marila*	310 000	Spring	1.68	Moderate	Local	Low
		Autumn	0.09	Irrelevant	Irrelevant	
Geese* *Anseridae*	>3 500 000	Spring	0.1	Irrelevant	Irrelevant	Moderate
		Autumn	1.7	Moderate	Local	
Swans *Cygnus* sp.	300 000	Spring	0.15	Irrelevant	Irrelevant	Low
		Autumn	0.43	Irrelevant	Irrelevant	
Divers *Gaviidae*	>400 000	Spring	0.76	Irrelevant	Irrelevant	Low
		Autumn	0.05	Irrelevant	Irrelevant	
Auks *Alcidae*	>5 000 000	Spring	0.06	Irrelevant	Irrelevant	Low
		Autumn	0.15	Irrelevant	Irrelevant	
Great black cormorant *Phalacrocorax carbo*	515 000	Spring	0.17	Irrelevant	Irrelevant	Low
		Autumn	0.25	Irrelevant	Irrelevant	
Little gull *Hydrocoloeus minutus*	>72 000	Spring	10.32	Very significant	Global	Low
		Autumn	0.27	Irrelevant	Irrelevant	
Black-headed gull *Larus ridibundus*	>4 770 000	Spring	0.01	Irrelevant	Irrelevant	Low
		Autumn	0.08	Irrelevant	Irrelevant	

Taxon/category	Population of migratory birds	Migration season	Proportion of population of birds in flight [%]	Significance of vulnerable population	Size of vulnerable population	Receptor value/significance
Lesser black-backed gull *Larus fuscus*	>1 200 000	Spring	0.16	Irrelevant	Irrelevant	Low
		Autumn	0.09	Irrelevant	Irrelevant	
Common gull *Larus canus*	1 200 000	Spring	0.32	Irrelevant	Irrelevant	Low
		Autumn	0.11	Irrelevant	Irrelevant	
Terns *Sternidae*	>1 800 000	Spring	0.02	Irrelevant	Irrelevant	Low
		Autumn	0.01	Irrelevant	Irrelevant	
Charadriiformes *Charadriiformes*	>1 600 000	Spring	0.03	Irrelevant	Irrelevant	Low
		Autumn	0.08	Irrelevant	Irrelevant	
Common crane** *Grus grus*	240 000	Spring	0.4	Irrelevant	Irrelevant	High
		Autumn	-	None	None	
Passerines *Passeriformes*	100 000 000	Spring	0.01	Irrelevant	Irrelevant	Low
		Autumn	0.14	Irrelevant	Irrelevant	

**Average abundance of geese estimated on the basis of all available inventory data is 3390 in spring and 59 190 in autumn, which corresponds to 0.10% and 1.70% of the population of local significance*

***Average abundance of the common crane estimated on the basis of all available inventory data is 360 in spring and 2790 in autumn, which corresponds to 0.15% and 1.17% of the population of local significance*

3.7.1.6 Seabirds

Seabird observations were conducted in the Baltic Power OWF Area including the buffer zone with a width of 2 NM and in three additional areas of great significance to birds: the Słupsk Bank, the Baltic Coastal Waters Area and the Polish part of the Southern Middle Bank Area. Observations were conducted in the period from October 2018 to November 2019. Detailed survey results for these areas are included in Appendix 1 to the EIA Report.

The Baltic Sea area is used by seabirds as a location for wintering or a stopover during migration. Most of the birds surveyed reach the greatest abundances in the offshore zone, located more than 1 km away from the shore. Gulls which accompany fishing boats to fishing grounds are an exception and their occurrence in the open sea is strongly conditioned by human activity.

Species composition of birds sitting on the water in the Baltic Power OWF Area

During the observations conducted in the Baltic Power OWF Area (2NM), a total of 19 bird species staying in the sea area were recorded, including 13 species connected to the marine environment and two species of water birds rarely encountered at sea away from the coast (Table 3.12, Figure 3.16).

Table 3.12. Abundance and percentage share in the group of individual bird species sitting on the water, found in the Baltic Power OWF Area (2NM) along the cruise route within the entire period between October 2018 and November 2019.

Species	Number of individuals observed	Share in the group
Seabirds		
Long-tailed duck *Clangula hyemalis*	4237	76.1%
European herring gull *Larus argentatus*	484	8.7%
Common guillemot *Uria aalge*	417	7.5%
Razorbill *Alca torda*	236	4.2%
Velvet scoter *Melanitta fusca*	45	0.8%
Great black-backed gull *Larus marinus*	14	0.3%
Common scoter *Melanitta nigra*	11	0.2%
Little gull *Hydrocoloeus minutus*	8	0.1%
Black-throated diver *Gavia arctica*	8	0.1%
Lesser black-backed gull *Larus fuscus*	7	0.1%
Red-throated diver *Gavia stellata*	5	0.1%
Black guillemot *Cepphus grylle*	2	+
Common eider *Somateria mollissima*	1	+
Water birds rarely encountered at sea away from the coast		
Common gull *Larus canus*	7	0.1%
Black-headed gull *Chroicocephalus ridibundus*	7	0.1%

Species	Number of individuals observed	Share in the group
Great black cormorant *Phalacrocorax carbo*	5	0.1%
Eurasian coot *Fulica atra*	1	+
Arctic tern *Sterna paradisaea*	1	+
Greater white-fronted goose *Anser albifrons*	1	+
Birds unidentified as to species		
Razorbill or a common guillemot *Alca torda/Uria aalge*	59	1.1%
Unidentified specimen of gaviiformes *Gavia* sp.	6	0.1%
Unidentified geese *Anserinae*	3	0.1%
Unidentified passerines *Passeriformes*	1	+
Total	5566	100%

+ – percentage share smaller than 0.1%

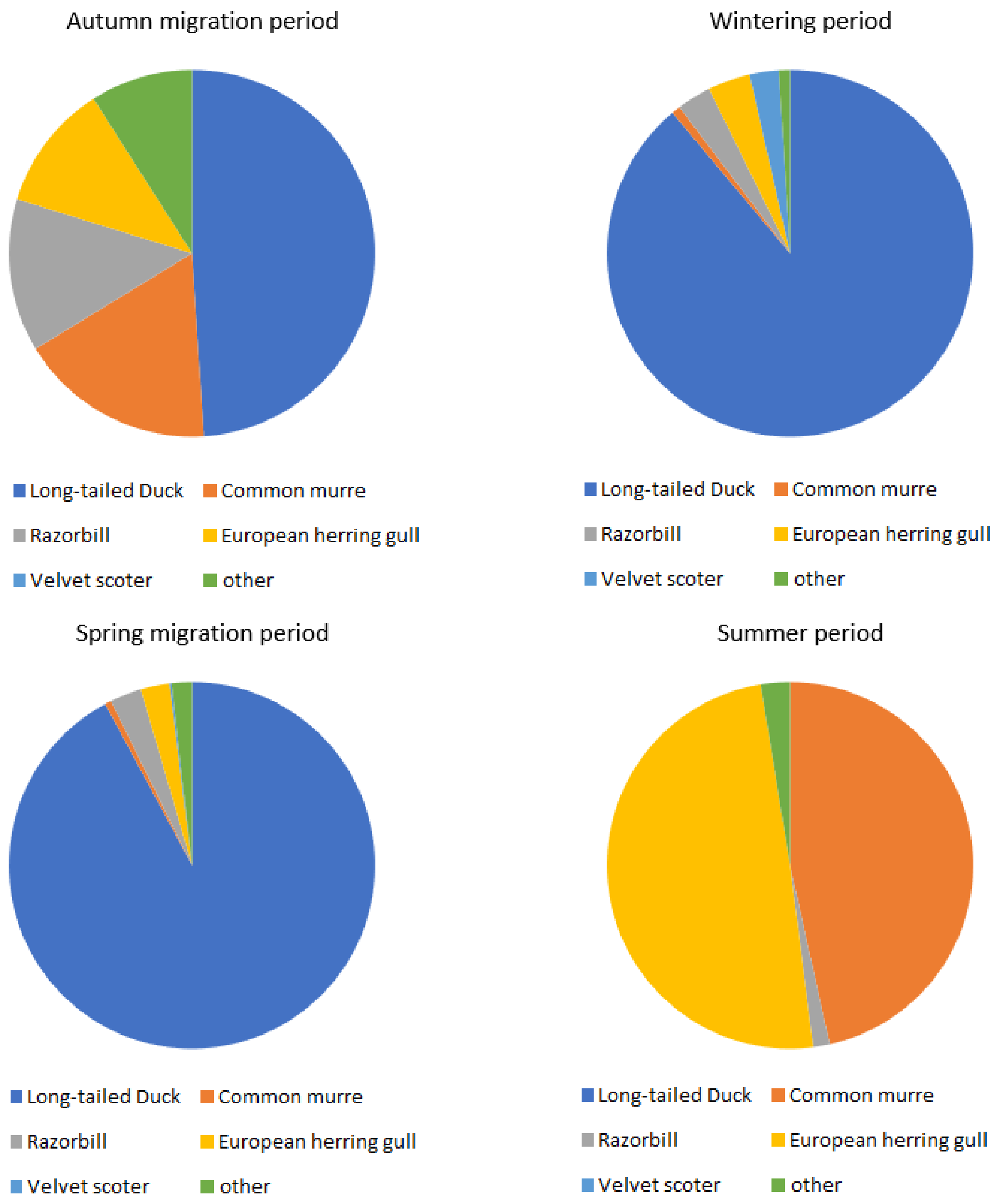


Figure 3.16. Share of the prevailing species of birds sitting on the water in the entire group of birds in the Baltic Power OWF Area (2 NM) within the entire period from October 2018 to November 2019 [Source: Baltic Power Sp. z o.o. data]

In total, 5566 individuals of seabirds were observed along the transects in the Baltic Power OWF Area (2NM). The category of "water birds rarely encountered at sea away from the coast" includes 6 species (the common gull, the black-headed gull, the great black cormorant, the Eurasian coot, the arctic tern, and the greater white-fronted goose). Most cases of undetermined species affiliation concerned the razorbill and the common guillemot, i.e. the species which are very similar and difficult to distinguish from a greater distance. They feed mainly on pelagic fish, have similar habitat requirements [85] and react in a similar way to offshore wind farms located in maritime areas [84].

The species structure of seabird groupings observed in the OWF Area with the dominance of the long-tailed duck and a high share of the European herring gull (in summer) is typical for the majority of sea areas situated in the Polish zone of the Baltic Sea away from the coast [75, 383, 382, 27].

In the OWF Area (2 NM), the long-tailed duck was the most abundant species, prevailing in the autumn migration period, in the wintering period and in the spring migration period. It is a species widely spread in the Baltic Sea, concentrating mostly in areas of moderate depth (up to 20–30 m) rich in zoobenthos, which constitutes its food supply. The Słupsk Bank Natura 2000 site is one of the more important wintering grounds of this species in the Baltic Sea [110, 379]. The second most commonly observed species in the OWF Area (2 NM) was the European herring gull (the species prevailing in summer), which is a relatively wide spread species in the Baltic Sea area and is not a species of high conservation priority, remaining only under partial protection. Birds of this species penetrate the sea area in search of food, mainly waste generated as a result of hauls and fish processing conducted on fishing boats [382, 383, 145, 147]. Because of that, they often accompany fishing boats at fisheries away from the coast. Therefore, the majority of herring gull observations during surveys were of individuals flying above the surface of water.

The results of avifauna observations covering four phenological periods indicated that the Baltic Power OWF Area is not a place of very high concentrations of seabirds in the period of their most abundant occurrence in the Baltic Sea (maps of concentrations included in Appendix 1 to the EIA Report). The most abundant species, which was the long-tailed duck, reached a density from 0.1 ind. km^{-2} in the autumn migration period to 100 ind. km^{-2} in the wintering period.

In the Baltic Power OWF Area, the presence of 12 bird species under strict protection in Poland (the long-tailed duck, the razorbill, the common guillemot, the velvet scoter, the great black-backed gull, the common scoter, the little gull, the red-throated diver, the lesser black-backed gull, the black-throated diver, the black guillemot and the common eider) and a single species under partial protection (the European herring gull) was confirmed. Three species of birds staying in the sea area are mentioned in Annex I of the EU Birds Directive (the little gull, the red-throated diver and the black-throated diver). One species of birds (the black guillemot) is classified as SPEC 2, and four species (the velvet scoter, the little gull, the red-throated diver and the black-throated diver) are classified as SPEC 3. Three of the species observed (the long-tailed duck, the velvet scoter, the common eider) belong to the category of VU (vulnerable), and the razorbill to NT (near threatened), in accordance with the classification of the International Union for the Conservation of Nature (IUCN) for the world, used also by HELCOM.

Detailed information on the results of seabird observations can be found in Appendix 1 to the EIA Report.

Species composition of birds sitting on the water in the additional areas of great significance to birds

As part of the observations in the following additional areas of great significance to birds: the Słupsk Bank, the Baltic Coastal Waters Area and the Polish part of the Southern Middle Bank Area, a total of 23 species of birds staying in the sea area were recorded, including 15 species connected to the marine environment and 8 species of water birds rarely encountered at sea away from the coast (Table 3.13). The category of “water birds rarely encountered at sea away from the coast” includes 8 species (the common gull, the great black cormorant, the mute swan, the great crested grebe, the black-headed gull, the Eurasian wigeon, the greater white-fronted goose and the red-breasted merganser).

Table 3.13. Abundance and percentage share in the group of individual bird species sitting on the water, found in the additional areas of great significance to birds in the periods from October 2018 to April 2019 and from October 2019 to November 2019

Species	**Number of individuals observed**	**Share in the group**
Seabirds		
Long-tailed duck *Clangula hyemalis*	82 278	66.3%
Velvet scoter *Melanitta fusca*	36 853	29.7%
European herring gull *Larus argentatus*	2273	1.8%
Razorbill *Alca torda*	1274	1.0%
Common scoter *Melanitta nigra*	409	0.3%
Common guillemot *Uria aalge*	328	0.3%
Black guillemot *Cepphus grylle*	80	0.1%
Black-throated diver *Gavia arctica*	68	0.1%
Great black-backed gull *Larus marinus*	55	+
Red-throated diver *Gavia stellata*	29	+
Little gull *Hydrocoloeus minutus*	28	+
Lesser black-backed gull *Larus fuscus*	21	+
Horned grebe *Podiceps auritus*	5	+
Red-necked grebe *Podiceps grisegena*	5	+
Great skua *Catharacta skua*	2	+
Water birds rarely encountered at sea away from the coast	**94**	**+**
Birds unidentified as to species	**308**	**0.2%**
Total	124 110	100.0%

+ – percentage share smaller than 0.1%

The detailed results of seabird surveys conducted in the Baltic Power OWF Area and in the additional areas of great significance to birds including their analysis are included in Appendix 1 to the EIA Report.

Species of seabirds included in the Environmental Impact Assessment

Birds present (sitting on the water or flying) along the transects during the survey campaigns conducted were included in the Baltic Power OWF Environmental Impact Assessment. The assessment does not include the results obtained from the radar surveys, dealing with the issue of avifauna migration in detail. In the case of the European herring gull, which was present during the surveys conducted with the application of both methods, the assessment scope of the potential OWF impacts is presented in the part on seabirds. The European herring gull is a species that accompanies fishing boats at fishing grounds and its occurrence in the open sea is strongly conditioned by human activity. The assessment involved the most abundant species of seabirds, the share of which in the abundance of the entire grouping of birds observed in the OWF reached 1% within at least one phenological period or which are the subject of protection in the nearest Natura 2000 sites.

As a result, 7 species of birds were taken into consideration. The condition of at least 1% share in the abundance of the entire group was met by: the long-tailed duck, the razorbill, the common guillemot and the European herring gull. The species, which did not meet the above-mentioned condition, but which are subject to protection in the nearest Natura 2000 sites, are the black guillemot and the common scoter. The black guillemot is the subject of protection in the Słupsk Bank (PLC990001) and Przybrzeżne wody Bałtyku (PLB990002) Natura 2000 sites, but its abundance in the OWF Area was very low. In total, only a single individual was recorded during the winter survey campaigns. Whereas, the common scoter is the subject of protection in the Przybrzeżne wody Bałtyku (PLB990002) Natura 2000 site, but its abundance in the winter in that area was very low – 19 individuals found along the route of survey cruises, and no individuals in the OWF Area. As a result, the black guillemot and the common scoter were included in the assessment only in the context of the OWF impact on the Natura 2000 sites [subsection 6.3].

3.7.1.7 Bats

The surveys aimed at determining the impact of wind farms on bats were initiated at the end of the last century and were carried out as part of the surveys on the impact of such projects on the avifauna. Numerous publications have indicated that sometimes the number of dead bats had exceeded the number of dead birds found within the areas of onshore wind farms located in the vicinity of forest areas, but also in exposed areas [19]. Collisions of bats have also been reported in the areas of offshore wind farms [4, 2, 184]. On the basis of surveys conducted onshore, it has been found that 20 species of European bats are killed as a result of a collision with a wind power station, and 21 species are potentially vulnerable. The majority of these species are migratory and open-space foraging species [439, 352, 159].

Comparative mortality results for OWFS are not available, since mortality at sea cannot be estimated using the conventional monitoring methods. However, it is assumed that the risk of collision at OWFS may be increased, especially during migratory periods [351].

Currently, there is little data available on the activity of bats on the coasts and at sea. However, sea-related habitats can be especially significant for bats migrating over long distances [79].

Ringing and direct observations have shown that many bat species from Scandinavia and North-Eastern Europe migrate seasonally to Central Europe. In the case of some bat species, such as the common noctule (*Nyctalus noctula*), the Nathusius' pipistrelle (*Pipistrellus nathusii*), the parti-coloured bat (*Vespertilio murinus*) and the lesser noctule (*Nyctalus leisleri*), flights over long distances from 1500 to 2000 km per season have been observed [188]. Long-distance migration flights have also been detected by measuring stable isotopes in the common noctule, particularly in northern Europe [246]. The mentioned species migrating over long distances migrate also across the Baltic Sea in spring and autumn [374].

Many surveys on bat migrations have been conducted in Scandinavia and they have demonstrated that sudden increases in bat activity in the autumn migration season occur along the southern coast of Sweden and are indicative of the beginning of seasonal migrations (in small groups or individually) in the direction of wintering grounds located in Central and Western Europe [2]. High activity of the Nathusius' pipistrelle during the migration period has been, for example, recorded on the west coast of Finland [194]. It is assumed that bats begin the migration across the Baltic Sea from the region of their summer hideouts in the northern part of Europe, in the south – south-western directions. Bat migrations over the sea area are of dispersed nature, which makes it impossible to designate bat flyways [370]. Additionally, it is assumed that bats migrate along characteristic landscape features, such as, for example, the coastline. As a result, the entire Baltic Sea coastline, as well as the islands are of great significance to the migration of bats [360].

In Poland, there are no binding legal regulations concerning the bat survey methodology in the context of offshore wind farms. In relation to the above, the bat activity surveys in the Baltic Power OWF Area were based on the project entitled "Guidelines for assessing the impact of wind farms on bats" [213] and in the Annex to the Resolution No. 7.5 "The Agreement on the Conservation of Populations of European Bats EUROBATS" [351]. In compliance with the above-mentioned guidelines, the surveys of bat activity in the Baltic Power OWF Area were conducted on the same principles as the ones applied in the monitoring of bats on land. However, all inspections were conducted throughout the night and the surveys were limited to the periods of expected seasonal migrations, such as the spring and autumn migrations.

The surveys on bat activity in the Baltic Power OWF Area were conducted from April to May 2019 (spring migration) and from August to October 2019 (autumn migration). The recording of acoustic signals was conducted during a vessel cruise, which sailed along the transects designated with a total length of approx. 55 km and at two survey (monitoring) stations. The recordings at the monitoring stations were conducted from aboard an anchored vessel. In the case of vessel traffic near the survey station, for safety reasons, maintaining position by drifting and manoeuvring using the vessel propulsion was allowed. In total, 14 survey campaigns were conducted – 6 during the spring migration and 8 during the autumn migration. In addition, as part of the autumn migration, campaigns in September were initiated 3 hours before sunset, in order to confirm the migration of the common noctule.

During the spring and autumn migration periods, 11 and 72 audio files were recorded respectively, which contained call sequences characteristic for bats. Bat call sequences were assigned to three species of bats (the Nathusius' pipistrelle, the soprano pipistrelle and the common noctule). Additionally, since some signals were impossible to assign to a specific species, they were classified as belonging to the Nyctaloid group (which includes individuals belonging to the following three genera: *Nyctalus* spp., *Vespertilio* spp. and *Eptesicus* spp. with similar sonograms, the identification of which as to the species was impossible).

The Nathusius' pipistrelle was the most numerous species. Its activity during the entire survey period was low, despite a single high activity recorded in August. It resulted from a large number of bat call sequences recorded within a short period of time (45 minutes of recordings during a single night of surveys). Due to a one-time nature of the phenomenon observed and a short recording period, the increased activity was probably caused by the bats feeding in the vicinity of the research vessel. The feeding process may have been induced by the phenomenon of insects being attracted by the illumination of the research vessel, from aboard which the monitoring activity was conducted. The second most abundant species observed was the soprano pipistrelle, however, its activity was also low. The common noctule was the least numerous in the Baltic Power OWF Area. Only two call sequences characteristic for this species were recorded, which also indicates low activity. The activity indices recorded for the groups identified divided into migration seasons are presented in the table (Table 3.14).

Table 3.14. Average activity index for the entire spring-autumn migration season divided into individual groups of bats with the activity categories assigned

Species group	Spring migration		Autumn migration	
	Average index [n·h^{-1}][2]	Category of activity[3]	Average index [n·h^{-1}][2]	Category of activity[3]
Pipistrellus spp.	0.3	A	0.6	A
Nyctalus spp.	0.1	A	<0.1	A
Nyctaloid[1]	0.0	A	0.1	A
All bats	0.4	A	0.7	A

[1]Includes the call sequences assigned to a group of genera (Nyctalus + Eptesicus + Vespertilio spp.), which were impossible to assign to a specified species

[2]Average bat activity index calculated on the basis of the arithmetic average of individual inspection indices after the removal of the lowest value obtained in a given period

[3]A – low activity class

Within the entire survey period, the activity of three bat species (the Nathusius's pipistrelle, the soprano pipistrelle and the common noctule) was recorded quite regularly. Two of those species, the Nathusius' pipistrelle and the common noctule, belong to the species migrating over significant distances. They can be found almost everywhere in Europe. They use summer hideouts in the north-eastern part of Europe and spend the hibernation period in the south-western part of the continent. In recent years, changes in the behaviour of bats due to climate change have been observed more and more [44, 371]. As a result of global warming, the range of bat occurrence has been changing, and in consequence, bats may shorten or refrain from seasonal migrations.

The Nathusius' pipistrelle is known for its migrations over large distances reaching up to 1900 km between its summer and winter habitats, crossing the Baltic Sea on the way [2]. The same holds true for the common noctule, which migrates over distances of approx. 1600 km, and which has also been seen flying across the Baltic Sea [213, 2]. Unlike the two species mentioned above, the soprano pipistrelle is not classified as a migratory species. However, it has been recorded in the areas of offshore wind farms [2].

The statistics for the Nathusius's pipistrelle, as well as the common noctule show very high risk of mortality connected to wind power stations. High risk of mortality is based on the specific behaviour of these two species during flights. The Nathusius' pipistrelle and the common noctule are open-space foraging species – they fly fast and high with limited agility. According to Kepel *et al.* [213], in comparison to other species of bats the common noctule is the most vulnerable to death as a result of collisions with wind power plants in Europe. These data regards wind farms located on land. So far, no similar studies have been conducted for OWFs. The Nathusius' pipistrelle is the second most affected species in this context [213]. However, on the basis of the data collected in the years 2007–2011 by Gottfried *et al.* [159] among the 7 species, which are killed in Poland as a result of collisions with wind power stations, the Nathusius' pipistrelle was observed most commonly.

Unlike the Nathusius' pipistrelle and the common pipistrelle, the soprano pipistrelle hunts at lower altitudes, flying fast, but rather agilely. As a result, the risk of mortality as a result of a collision with wind farms for the soprano pipistrelle is relatively low. Nevertheless, according to Kepel *et al.* [213] this is still a high mortality risk.

The expected mortality risk at onshore wind farms according to Kepel *et al.* [213] is shown in the table (Table 3.15) for those species, which were recorded during the surveys conducted in the Baltic Power OWF Area. The species included in the Nyctaloid group are also listed in the table.

Table 3.15. Bat species recorded and their mortality risk at wind farms according to Kepel et al. [213]

Species	Protection status (IUCN Red List)*	Mortality recorded in Europe **	Risk of death at wind farms
Common noctule *Nyctalus noctula*	LC	+++	Very large
Lesser noctule *Nyctalus leiseri*	LC	+++	Very large
Greater noctule bat *Nyctalus lasiopterus*	VC	++	Very large
Northern bat *Eptesicus nilssonii*	LC	++	Moderate
Serotine bat *Eptesicus serotinus*	LC	+++	Moderate
Parti-coloured bat *Vespertilio murinus*	LC	++	Moderate
Nathusius' pipistrelle *Pipistrellus nathusii*	LC	+++	Very large
Soprano pipistrelle *Pipistrellus pygmaeus*	LC	+++	High

**IUCN Red List categories [196]: VU – Vulnerable, LC – Least Concern*

***Mortality recorded at onshore wind farms in Europe: + single, ++ regular, +++ high*

The activity indices calculated for different species for the entire spring and autumn migration periods, demonstrate low bat activity. Migration of bats takes place across the Baltic Power OWF Area, but its intensity is low, similar to that of other areas surveyed in the Southern Baltic [383, 382, 27].

3.7.2 Protected areas, including Natura 2000

The Baltic Power OWF Area is located outside the boundaries of the protected areas indicated in the Nature Conservation Act of 16 April 2004 (Journal of Laws of 2004, No. 92, item 880, as amended), including outside the European Ecological Network Natura 2000.

In relation to the Baltic Power OWF Area, the two nearest Natura 2000 protected areas situated in PMA are:

- Przybrzeżne wody Bałtyku (PLB990002);
- the Słupsk Bank (PLC990001).

At a distance of approx. 20 km away from the Baltic Power OWF Area, a terrestrial-marine Natura 2000 site – Ostoja Słowińska (PLH220023) and the terrestrial site – Pobrzeże Słowińskie (PLB220003) are situated.

At a distance of approx. 55 km away from the Baltic Power OWF Area, a Swedish Natura 2000 site Hoburgs bank och Midsjöbankarna (SE0330308) (Figure 3.17) is situated. Within the Ostoja Słowińska site (PLH220023), the main complex of the Słowiński National Park, including its part located in maritime areas, is situated.

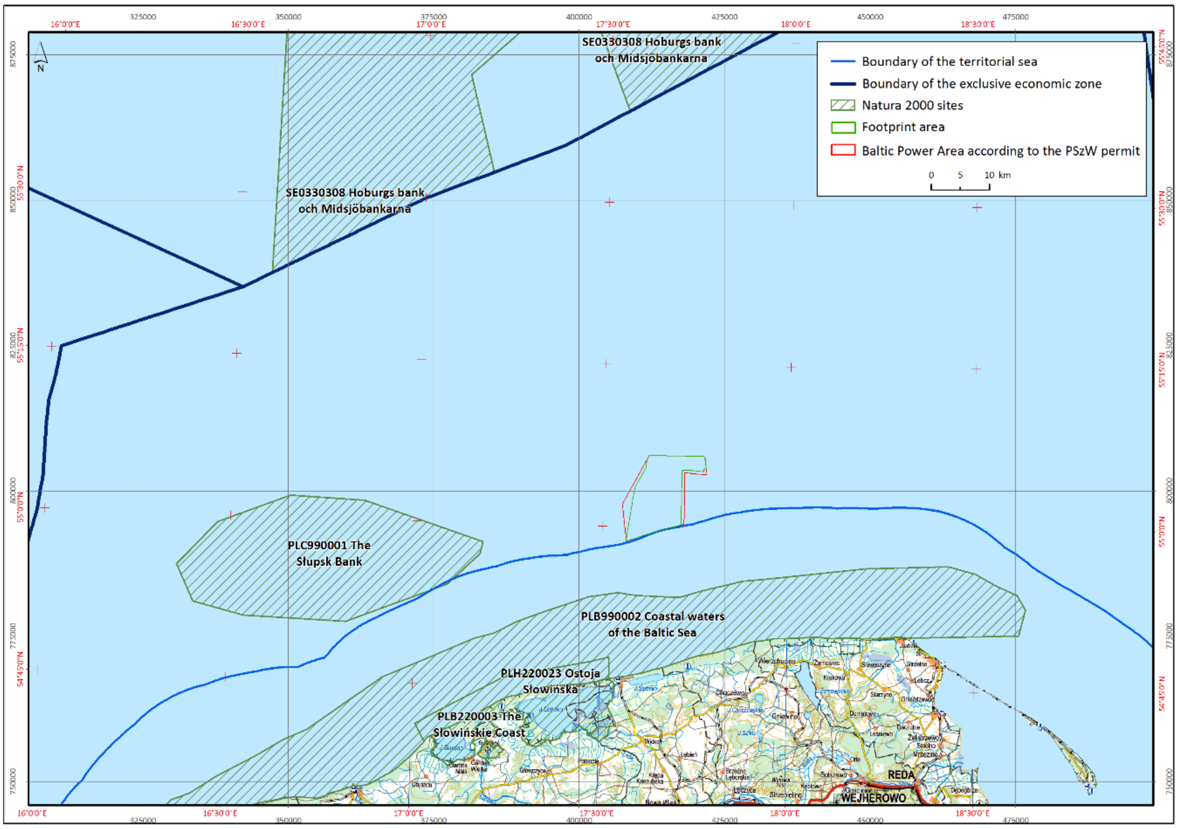


Figure 3.17. Location of the European Ecological Network Natura 2000 sites and the Baltic Power OWF Area [Source: internal materials]

Przybrzeżne Wody Bałtyku site (PLB990002)

The protected area nearest to the Baltic Power OWF Area is the Przybrzeżne wody Bałtyku site (PLB990002). The distance between those areas is almost 9 km (taking into consideration the nearest points of both areas). The Przybrzeżne wody Bałtyku site (PLB990002) includes a strip of the Southern Baltic coastal waters with a depth from 0 to 20 m and a length of approx. 200 km, which begins at the base of the Hel Peninsula and ends in the Pomeranian Bay. The seabed here is uneven with height differences reaching 3 m. Small crustaceans dominate in the benthic fauna. Two bird species from the list included in Annex I to the Birds Directive i.e. the black-throated diver and the red-throated diver winter in this area. In winter, more than 1% of the long-tailed duck migratory route population and at least 1% of the black guillemot and velvet scoter migratory route population are present there. From the species included in the Baltic Power OWF impact assessment on seabirds within the Przybrzeżne wody Bałtyku site (PLB990002), the wintering populations of the long-tailed duck, velvet scoter, razorbill and the European herring gull are subject to protection. It is estimated that 90–120 thousand individuals of the long-tailed duck, 14–20 thousand individuals of the velvet scoter, and 8–15 thousand individuals of the European herring gull winter in this area [279]. While the abundance of the razorbill population wintering in the area is estimated at 500 to 1000 individuals [154]. In the Przybrzeżne wody Bałtyku site (PLB990002), the wintering and passing population of the common scoter and the wintering population of the black guillemot are also under protection (Table 3.16). There is no protection plan available for this site.

During transect surveys in a fragment of the Przybrzeżne wody Bałtyku site (PLC990002), conducted for the purposes of the EIA Report, only a limited number of common scoters sitting on the water along the survey cruise route were observed. On the other hand, numerous individuals of the common scoter flew across the area in which the surveys were conducted. Therefore, the assessment of the Baltic Power OWF impact on the common scoter is included in the section on migratory birds. The number of the black guillemot individuals staying in the sea area surveyed was low and did not exceeded 1% of the bird group.

Table 3.16. Basic information on seabirds in the Przybrzeżne wody Bałtyku site (PLB990002) [Source: internal materials based on the: SDF Przybrzeżne wody Bałtyku (2019)]

Species	Population type	Assessment of the area for the population*	Population size in the area [number of individuals]		Percentage of the migratory population
			Minimal	Maximum	
Black-throated diver *Gavia arctica*	Wintering	D	200	500	Below 1%
Red-throated diver *Gavia stellata*	Wintering	D	100	500	Below 1%
European herring gull *Larus argentatus*	Wintering	C	8000	15 000	Below 1%
Common gull *Larus canus*	Wintering	D	1 000	1 000	Below 1%
Black guillemot *Cepphus grylle*	Wintering	B	1500	1500	At least 1%
Razorbill *Alca torda*	Wintering	C	500	1 000	Below 1%
Long-tailed duck *Clangula hyemalis*	Wintering	B	90 000**	120 000**	Above 1%
Velvet scoter *Melanitta fusca*	Wintering	C	14 000**	20 000**	At least 1%
Common scoter *Melanitta nigra*	Wintering	C	5000	8000	Below 1%
	Passing	C	3000	3000	Below 1%

**Estimating the size of the species population and its density in relation to the national population; class ranges: A: 100 ≥ p > 15%, B: 15 ≥ p > 2%, C: 2 ≥ p > 0%; area assessment for population D (species which are not the subject of protection in the area)*

***In the SDF, the size of the population was given incorrectly. The values cited here are taken from BirdLife International (http://www.birdlife.org/datazone/sitefactsheet.php?id=9563; accessed on: 16.06.2017) containing data provided in the SDF form*

Słupsk Bank site (PLC990001)

The boundary of the Baltic Power OWF Development Area is located at a distance of at least 25 km from the Słupsk Bank site (PLC990001) designated under the Birds Directive and the Habitats Directive.

The Słupsk Bank site (PLC990001) includes a subsea bank with a seabed significantly shallower than the areas surrounding it. Its boundary is roughly corresponds to the course of the 20 m isobath. The area has a very diversified seabed structure with numerous lowerings and elevations. The shallow patches are inhibited by numerous invertebrates, at the same time constituting a food supply for the seabirds staying there, especially in the wintering season.

The prevailing plants are macroalgae, including, for example, the red algae: *Furcellaria lumbricalis*, *Ceramium diaphanum*, *Polysiphonia fucoides* [238]. Two bird species from the list included in Annex I to the Birds Directive i.e. the black-throated diver and the red-throated diver winter in in this area. During winter, at least 1% of the long-tailed duck and the black guillemot migratory route population are present here. Seabirds occur in abundances exceeding 20 000 individuals.

Within the boundaries of the Natura 2000 site the Słupsk Bank (PLC990001), there are two bird species which are subject of protection in this area (Table 3.17):

- the black guillemot;
- the long-tailed duck,

and two natural habitats which are the subject of protection in this area (Table 3.18):

- Sublittoral sandbanks (1110);
- Reefs (1170).

Table 3.17. Basic information on seabirds in the Słupsk Bank site (PLC990001) [Source: internal materials based on: http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=PLC990001]

Species	**Population type**	**Evaluation of the area for the population***	**Population size in the area [number of individuals]**		**Percentage of the migratory population**
			Minimum	**Maximum**	
Black guillemot *Cepphus grylle*	Wintering	C	400**	1000**	At least 1%
Long-tailed duck *Clangula hyemalis*	Wintering	B	25 000**	32 000**	At least 1%
Black-throated diver *Gavia arctica*	Wintering	D	-	-	Below 1%
Red-throated diver *Gavia stellata*	Wintering	D	140	140	Below 1%

**Class ranges: A: 100 ≥ p > 15%, B: 15 ≥ p > 2%, C: 2 ≥ p > 0%; area assessment for population D (species which are not the subject of protection in the area)*

***In the SDF the size of the population was given incorrectly. The values cited here are taken from BirdLife International (http://www.birdlife.org/datazone/sitefactsheet.php?id=9562; accessed on: 16.06.2017) containing data provided in the SDF form*

The long-tailed duck was the bird species most frequently observed during the transect surveys in the years 2018–2019 and was, unlike the very rare black guillemot, included in the assessment of the Baltic Power OWF impact on seabirds. During the surveys conducted for the purposes of the EIA Report for the OWF Bałtyk III project, the abundance of the long-tailed ducks wintering within the Słupsk Bank area was estimated at about 120 thousand, which considerably exceeds the values specified in the Standard Data Form for this area, and even the data provided by the BirdLife International organisation. According to the data from literature, (the surveys conducted between 2012–2014) 2850 individuals of the black guillemot were observed within this area in winter [383].

The detailed information on the avifauna of the Słupsk Bank site and the Baltic Power OWF Area, including the presentation and discussion on the results of the water bird and migratory bird surveys conducted for the purposes of the EIA Report, are included in Appendix 1 to the EIA Report.

The Sublittoral sandbanks habitat (1110) (Table 3.18) within the Słupsk Bank site (PLC990001) is one of the three such habitats in the PMA. The conventional habitat boundary is the 20 m isobath [123]. In the Słupsk Bank site, mainly sandy-gravel sediments are deposited with local islands of stones and postglacial boulders.

The Reefs habitat (1170) (Table 3.18) is located in the north-western part of the Słupsk Bank site. It is a unique area for the southern part of the Baltic Sea due to the nature of its geological structure and the type of bedrock [228, 232, 231]. So far, this is the only location identified in the PMA, away from the shore, with abundant presence of macroalgae growing on the stony seabed [307, 12].

Table 3.18. Basic information on the natural habitats within the Słupsk Bank site (PLC990001) [Source: internal materials based on the SDF Słupsk Bank (2017)]

Code of the habitat	Name of the habitat	Surface [ha]	Representativeness[1]	Relative surface[2]	Conservation status[3]	General assessment[4]
1110	Sublittoral sandbanks	16 010.06	A	A	A	A
1170	Reefs	48 030.18	A	A	A	A

[1]Classification scheme for the representativeness assessment: A: excellent, B: good, C: significant, D: negligible representativeness

[2] Class ranges: A: 100 ≥ p > 15%, B: 15 ≥ p > 2%, C: 2 ≥ p > 0%

[3]Classification scheme for the conservation status assessment: A: excellent, B: good, C: average or reduced status

[4]Classification scheme for the general assessment: A: excellent, B: good, C: significant

Ostoja Słowińska site (PLH220023)

In contrast to the two previously discussed protection areas, the Ostoja Słowińska site (PLH220023) is a terrestrial-marine area. Its marine boundary is located approx. 21 km away from the Baltic Power OWF Area. The maritime part of the Ostoja Słowińska site (PLH220023) covers a strip of coastal waters with a width of approx. 2 NM within the boundaries of the Słowiński National Park. The marine area of the Ostoja Słowińska site (PLH220023) is the habitat of two marine mammal species and five fish and lamprey species connected to the marine environment (Table 3.19). In the western part of the area, there is a boulder area, which is a natural habitat of the Reefs (1170) (Table 3.20).

Table 3.19. Basic information on the species of marine mammals, fish and lampreys connected to the marine environment in the Ostoja Słowińska site (PLH220023) [Source: internal materials based on the SDF Ostoja Słowińska (2017)]

Species	Population type	Area assessment			
		Population[1]	Conservation status[2]	Isolation[3]	In total[4]
Grey seal *Halichoerus grypus*	Migrating	C	B	B	B
Harbour porpoise *Phocoena phocoena*	Migrating	B	B	B	B
Twait shed *Alosa fallax*	Migrating	C	B	C	C
River lamprey *Lampetra fluviatilis*	Migrating	B	B	C	B
Sabrefish *Pelecus cultratus*	Settled	C	B	C	C
Sea lamprey *Petromyzon marinus*	Migrating	C	B	C	B
Atlantic salmon *Salmo salar*	Migrating	D	-	-	-

[1]Estimation of the species population size and density in relation to the national population; class ranges: A: 100 ≥ p > 15%, B: 15 ≥ p > 2%, C: 2 ≥ p > 0%; area assessment for population D (species which are not the subject of protection in the area)

[2]Classification scheme for the conservation status assessment: A – excellent; B – good; C – average or reduced conservation status

[3]Classification scheme for the isolation assessment: A: population (almost) isolated; B: population not isolated, but occurring at the peripheries of the species range; C: population not isolated within a large area of occurrence

[4]Classification scheme for the general assessment: A – excellent; B – good; C – significant

Table 3.20. Basic information on natural habitats occurring within the maritime part of the Ostoja Słowińska site (PLH220023) [Source: internal materials based on the SDF Ostoja Słowińska (2017)]

Code of habitat	Name of habitat	Surface [ha]	Representativeness[1]	Relative surface area[2]	Conservation status[3]	General assessment[4]
1170	Reefs	402.06	B	C	A	B

[1]Classification scheme for the representativeness assessment: A: excellent, B: good, C: significant, D: negligible representativeness

[2] Class ranges: A: 100 ≥ p > 15%, B: 15 ≥ p > 2%, C: 2 ≥ p > 0%

[3]Classification scheme for the conservation status assessment: A: excellent, B: good, C: average or reduced status

[4]Classification scheme for general assessment: A: excellent, B: good, C: significant

Pobrzeże Słowińskie site (PLB220003)

A terrestrial area with a surface area of 21 819.43 ha, including the morphologic forms present on the Gardnieńsko-Łebska Spit, with unique coastal barchans and the two largest brackish water lakes – Lake Łebsko and Lake Gardno – with the adjacent meadows, peatlands, woods and forests. In the Pobrzeże Słowińskie site (PLB220003), included in the Ramsar Convention, there are at least 28 species of birds from Annex I of the EU Birds Directive, however, mostly connected to the terrestrial environments (Table 3.21). In the migration period, at least 1% of the migratory route population of three water bird species – the smew, the bean goose and the goosander – are present here. The great black cormorant, the greater white-fronted goose and the Eurasian wigeon occur in relatively high abundances. Also, a large population of the European herring gull nests within this site. The subject of protection in this area are the migratory populations of the greater white-fronted goose, the bean goose *sensu lato*, the common pochard, the smew, the goosander and the great black cormorant, as well as the breeding population of the European herring gull. Of these species, only the European herring gull was included in the assessment of the Baltic Power OWF impact on seabirds. According to the Standard Data Form for this area, this population has 400 individuals of the European herring gull (less than 1% of the migratory route population).

Table 3.21. Basic information on seabirds in the Pobrzeże Słowińskie site (PLB220003) [Source: internal materials based on the SDF Pobrzeże Słowińskie (2019)]

Species	Population type	Assessment of the area for the population*	Population size in the area [number of individuals]	
			Minimum	Maximum
Włochatka *Aegolius funereus*	Residing	D	1	1
Eurasian wigeon *Anas penelope*	Passing	D	1	3000
Mallard *Anas platyrhynchos*	Passing	D	1	6500
Greater white-fronted goose *Anser albifrons*	Passing	C	1000	6200
Bean goose *sensu lato* *Anser fabalis*	Passing	A	3200	4500
Golden eagle *Aquila chrysaetos*	Breeding	B	-	1
Lesser spotted eagle *Aquila pomarina*	Breeding	D	-	1
Short-eared owl *Asio flammeus*	Passing	D	-	2

Species	**Population type**	**Assessment of the area for the population***	**Population size in the area [number of individuals]**	
			Minimum	**Maximum**
Common pochard *Aythya ferina*	Passing	C	1	1500
Eurasian bitter *Botaurus stellaris*	Breeding	D	2	4
Eurasian eagle-owl *Bubo bubo*	Settled	B	5	5
Dunlin *Calidris alpine*	Breeding	D	-	-
	Passing	D	140	140
European nightjar *Caprimulgus europaeus*	Breeding	D	30	30
Common ringed plover *Charadrius hiaticula*	Breeding	C	10	10
White stork *Ciconia ciconia*	Breeding	D	15	25
Black stork *Ciconia nigra*	Breeding	D	-	1
Western marsh harrier *Circus aeruginosus*	Breeding	D	7	9
Hen harrier *Circus cyaneus*	Breeding	D	-	-
Montagu's harrier *Circus pygargus*	Breeding	D	4	5
Corn crake *Crex crex*	Breeding	C	200	250
Whooper swan *Cygnus cygnus*	Passing	B	560	560
Common crane *Grus grus*	Passing	C	7000	7000
White-tailed eagle *Haliaeetus albicilla*	Breeding	D	4	4
	Passing	D	10	30
European herring gull *Larus argentatus*	Breeding	B	400	400
Lesser black-backed gull *Larus fuscus*	Breeding	D	2	2
Smew *Mergus albellus*	Passing	B	1700	1700
Goosander *Mergus merganser*	Passing	C	1	2100
Black kite *Milvus migrans*	Breeding	D	-	1
Red kite *Milvus milvus*	Breeding	C	7	8
Osprey *Pandion haliaetus*	Breeding	D	-	1
European honey buzzard *Pernis apivorus*	Breeding	D	1	1
Great cormorant *Phalacrocorax carbo sinensis*	Breeding	C	200	200
Ruff *Philomachus pugnax*	Passing	D	380	380

Species	Population type	Assessment of the area for the population*	Population size in the area [number of individuals]	
			Minimum	Maximum
Spotted crake *Porzana porzana*	Breeding	D	-	4
Little tern *Sterna albifrons*	Breeding	D	-	3
Common tern *Sterna hirundo*	Breeding	D	-	15

**Estimation of the species population size and density in relation to the national population; class ranges: A: 100 ≥ p > 15%, B: 15 ≥ p > 2%, C: 2 ≥ p > 0%; area assessment for population D (species which are not the subject of protection in the area)*

Słowiński National Park

The Słowiński National Park is one of the two terrestrial-marine national parks in Poland. Its surface area is 32 744 ha. The main object of protection in this park is the Łeba Spit, which forms a complex of unique geomorphological forms and locations, in which the natural processes of the coast modification take place. Valuable forest and non-forest communities, as well as aquatic ecosystems, including the two largest coastal lakes – Lake Gardno and Lake Łebsko – and a coastal sea area with a width of 2 NM are also present in the park.

Hoburgs bank och Midsjöbankarna (SE0330308)

The Hoburgs bank och Midsjöbankarna site (SE0330308) is situated approx. 56 km away from the Baltic Power OWF Development Area. The Hoburgs bank och Midsjöbankarna site (SE0330308) covers the Central Baltic area situated in the Swedish Maritime Areas, south of Öland and Gotland. Two natural habitats subject to protection are situated within its boundaries: Sublittoral sandbanks (1110) and Reefs (1170) (Table 3.22). Three bird species – the black guillemot, the long-tailed duck and the common eider (Table 3.23) as well as the porpoise population present there (Table 3.24) are the subject of protection in the Hoburgs bank och Midsjöbankarna site (SE0330308).

Table 3.22. Basic information on natural habitats occurring within the maritime part of the Hoburgs bank och Midsjöbankarna site (SE0330308) [Source: http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=SE0330308]

Code of habitat	Name of habitat	Surface [ha]	Representativeness[1]	Relative surface[2]	Conservation status[3]	General assessment[4]
1110	Sublittoral sandbanks	220 000	B	B	B	B
1170	Reefs	20 000	B	C	B	B

[1]Classification scheme for the representativeness assessment: A: excellent, B: good, C: significant, D: negligible representativeness
[2]Class ranges: A: 100 ≥ p > 15%, B: 15 ≥ p > 2%, C: 2 ≥ p > 0%
[3]Classification scheme for the conservation status assessment: A: excellent, B: good, C: average or reduced status
[4]Classification scheme for the general assessment: A: excellent, B: good, C: significant

Table 3.23. Basic information on seabirds in the Hoburgs bank och Midsjöbankarna site (SE0330308) [Source: internal materials based on: http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=SE0330308]

Species	Population type	Assessment of the area for the population*	Population size in the area	
			Minimal	Maximum
Black guillemot *Cepphus grylle*	Wintering	C	1000	5000

Species	Population type	Assessment of the area for the population*	Population size in the area	
			Minimal	Maximum
Long-tailed duck *Clangula hyemalis*	Wintering	A	200 000	1 000 000
Common eider *Somateria mollissima*	Migrating	C	5000	50 000

**Estimation of the species population size and density in relation to the national population; class ranges: A: 100 ≥ p > 15%, B: 15 ≥ p > 2%, C: 2 ≥ p > 0%; area assessment for population D (species which are not the subject of protection in the area)*

Table 3.24. Basic information on marine mammals connected to the marine environment in the Hoburgs bank och Midsjöbankarna (SE0330308) site [Source: http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=SE0330308]

Species	Population type	Area assessment			
		Population[1]	Conservation status[2]	Isolation[3]	In total[4]
Harbour porpoise *Phocoena phocoena*	Migrating	C	B	B	B

**Estimation of the species population size and density in relation to the national population; class ranges: A: 100 ≥ p > 15%, B: 15 ≥ p > 2%, C: 2 ≥ p > 0%; area assessment for population D (species which are not the subject of protection in the area)*
[2]Classification scheme for the conservation status assessment: A – excellent; B – good; C – average or reduced conservation status
[3]Classification scheme for the isolation assessment: A: population (almost) isolated; B: population not isolated, but occurring at the peripheries of the species range; C: population not isolated within a large area of occurrence
[4]Classification scheme for the general assessment: A – excellent; B – good; C – significant

3.7.3 Wildlife corridors

A wildlife corridor, pursuant to the Nature Conservation Act of 16 April 2004 (Journal of Laws of 2004, No. 92, item 880, as amended), is an area enabling the migration of plants, animals or fungi. A network of wildlife corridors connecting the European Ecological Network Natura 2000 in Poland was developed in 2011 [201], however, no wildlife corridors for the PMA were indicated therein. Krost *et al.* [237] emphasise the necessity to indicate wildlife corridors for the benthic organisms. However, this is a relatively poorly recognised issue. There are also no relevant studies on the Southern Baltic in that scope.

According to the general classification of the migration system of aquatic and wetland birds in Eurasia, Poland, including its marine areas, is located within two large flyways: the East Atlantic and the Mediterranean/Black Sea flyways. The migration tactics, as well as flyways of seabirds in the Baltic region are very poorly recognised. In summer (July and August), the flight of sea ducks (mainly the common scoter males) from the Gulf of Finland in the direction of the moulting grounds located in the Danish straits is observed. They are accompanied by the common eiders (*Somateria mollissima*) and velvet scoters, however, the abundance of these two species is much lower than that of the common scoter. These birds make a stop in the sea areas of the Southern Baltic only in exceptional cases. The period of seabird autumn migration is very extended in time. Starting in August, a series of water bird species can be observed within the PMA. Some of them are only passing and do not winter there (e.g. the terns of the *Sterna* and *Chlidonias* genera), others are observed throughout the entire migration and wintering periods (sea ducks, razorbills, divers, grebes). In spring, large flocks of sea ducks (long-tailed ducks, velvet scoters and common scoters), which travel towards feeding grounds, make a stop in the Polish zone of the Baltic Sea [373].

Also for the marine mammals occurring in the Southern Baltic, no areas that could meet the criteria for wildlife corridors can be identified. Both seals, as well as porpoises travel in search of food with no preference for specific routes.

3.7.4 Biodiversity

3.7.4.1 Phytobenthos

There are no phytobenthic species present in the Baltic Power OWF Area.

3.7.4.2 Macrozoobenthos

On the soft bottom (sandy sediment, gravel) in the OWF Area (1 NM) the presence of 25 macrozoobenthic taxa was confirmed, which belong to 6 classes: hydrozoans (Hydrozoa), bristle worms (Polychaeta), Hexanauplia, Malacostraca, Bivalvia, Gymnolaemata, and a single subclass of Oligochaeta and a group of priapulid worms (Priapulida). This diversified benthic macrofauna contains a group of absolutely constant species, which includes the polychaetes (*Marenzelleria* sp. and *Pygospio elegans*) and the Baltic clam (*Limecola balthica*), antinella (*Bylgides sarsi*) and *Monoporeia affinis* characterised by a wide range of tolerance to environmental factors. *Pygospio elegans* had the largest share in the dominance structure of the macrozoobenthos abundance on the soft bottom in the OWF Area (1 NM), and the Baltic clam (*Limecola balthica*) had the largest share in the biomass. On the hard bottom (boulders, stones), 16 taxa of invertebrate macrofauna were recorded, which belonged to 6 classes: hydrozoans (Hydrozoa), bristle worms (Polychaeta), Hexanauplia, Malacostraca, Bivalvia, Gymnolaemata, and a single subclass of Oligochaeta. In the abundance structure and biomass of the macrozoobenthos on the hard bottom, the bay mussel (*Mytilus* sp.) was dominant.

The taxa identified are the representatives of the invertebrate macrofauna typical and commonly occurring in the open waters of the Southern Baltic. In comparison to the results of the macrozoobenthos surveys conducted in the adjacent project areas: MFW Bałtyk III [383], MFW Bałtyk II [382] and MFW Baltica [27] [subsection 3.7.1.2], the results of quality structure of the macrozoobenthos community in the Baltic Power OWF Area are similar, characteristic of the shallow and medium deep seabed (up to 50 m b.s.l.) of the Eastern Gotland Basin, without any distinguishing characteristics in terms of composition and taxonomic diversity.

3.7.4.3 Ichthyofauna

The analysis of the catch results and catch efficiency for the fish community inhabiting the OWF Area demonstrates that the area is typical for the Southern Baltic in terms of species diversity, with a distinct prevalence of cod and flounder in demersal catches and of herring and sprat in pelagic catches.

In total, 144 fish species, including 97 marine species, 7 migratory species and 40 freshwater species, were recorded in the Baltic Sea [411]. The fish species prevailing in the deeper waters of the western Baltic Sea are cod and flounder in the demersal zone and herring and sprat in the pelagic zone [15, 221, 460, 189].

According to CIEP [240], a maximum of 44 fish species live in the open sea area, including the species occurring in the coastal and transitional waters.

A total of 22 fish species were observed in the Baltic Power OWF Area during surveys. In the case of ichthyoplankton, the roe of two fish species and larvae belonging to 11 taxa were caught. Throughout the entire survey period, sprat had the most significant share in the total larval abundance (92.1%) of the total larval abundance of all species, followed by gobies (4.5%) and flounder (1.6%). The larvae of the remaining 8 species, such as the common sea snail, the herring, the ammodytids, the fourbeard rockling, the shorthorn sculpin, the longspined bullhead, the rock gunnel and the European plaice were significantly less numerous (from 0.9% to 0.05%). During pelagic catches, 9 species of fish were caught, 99% of which were the sprat and the herring. The presence of single specimens of garfish, three-spined stickleback, great sand eel, anchovy, flounder, lumpfish and lesser sand eel was confirmed. During demersal fish catches, fish belonging to 13 taxa were recorded. The flounder and cod dominated, whereas other species constituted a small by-catch (great sand eel, plaice, shorthorn sculprin, pogge, fourbeard rockling, turbot, herring, viviparous eelpout, whiting, common dab).

3.7.4.4 Marine mammals

Three species of marine mammals may occasionally occur in the Baltic Power OWF Area: the harbour porpoise (*Phocoena phocoena*), the grey seal (*Halichoerus grypus*) and the harbour seal (*Phoca vitulina*). Additionally, there is a low probability of observing the ringed seal (*Pusa hispida*). For marine mammals, the Baltic Power OWF Area may be only a place of temporary passage in search for food.

3.7.4.5 Seabirds

The species diversity of seabird communities observed in the Baltic Power OWF Area varied depending on the season, in which the observations were conducted (Table 3.25).

During the autumn migration period, the presence of 15 species in the OWF Area including the buffer zone was confirmed. The most numerous of the species was the long-tailed duck constituting 49% of all the birds observed. Three other species had a share of at least 1% in the entire bird grouping, namely: the common guillemot (17.3%), the razorbill (13.5%), and the long-tailed duck (11.2%). The remaining species were much less abundant, and their joint abundance recorded during all nine inspections did not reach 100 birds.

In winter, the presence of a smaller number of species was recorded in comparison to the autumn migration period, i.e. 9 species. The long-tailed duck was definitely the most numerous species wintering in this sea area, constituting 88.9% of the entire bird grouping. No other species exceeded a 5% share in the grouping.

During the spring migration period, the presence of 12 seabird species was confirmed in the OWF Area. The most numerous of the species was definitely the long-tailed duck constituting 92.2% of all the birds confirmed. The share of 1% in the grouping was also exceeded by the razorbill (2.8%) and the European herring gull (2.5%). The remaining species were scarce. Moreover, 15 species unidentified as to the species were recorded in that period.

In summer, the presence of 8 seabird and water bird species rarely encountered at sea away from the coast was recorded in the Baltic Power OWF Area. The European herring gull and the common guillemot were the most numerous species.

Table 3.25. Number of species and the most numerous seabird species observed in the Baltic Power OWF Area in individual pheonological periods

Parameter	Autumn migration period	Wintering period	Spring migration period	Summer period
Number of species	15	9	12	8
Most abundant species	Long-tailed duck, common guillemot, razorbill, European herring gull	Long-tailed duck	Long-tailed duck, razorbill, European herring gull	European herring gull, common guillemot

3.7.5 Environmental valorisation of the sea area

The environmental valorisation of a particular sea area can be based on significant differences present within this area, in the context of both abiotic conditions, usually habitat-forming, and the resultant biotic conditions. Appropriate habitat conditions (type of seabed, quality of seabed sediments, depth, photic conditions) have a direct impact on the organisms that inhabit them, which either live permanently in such conditions or use a particular area temporarily.

The results of the comprehensive environmental surveys conducted for the purposes of the EIA Report demonstrate that the OWF Area is in the majority of cases homogeneous in terms of abiotic conditions. As a result, sections of sea areas with different natural values cannot be indicated.

The only element of the environment differentiating the OWF Baltic Power area, which can be used for its valorisation, is the depth of the sea area. It changes from 32 m in the southern part of the area to 45 m in its northern part. As a result, in winter, the shallowest, southern section of the Baltic Power OWF Area is characterised by greater concentrations of seabirds (the long-tailed duck and the velvet scoter). This is due to the fact that in the sea areas with smaller depths, benthivorous animals can obtain food using less energy, which is more beneficial for them. Therefore, it can be indicated that the southern part of the Baltic Power OWF Area is characterised by greater natural values due to more favourable conditions for the stay of this species of birds in comparison to the other parts of the area.

3.8 Cultural amenities, monuments and archaeological sites and objects

There are no underwater cultural heritage objects in the Baltic Power OWF Area.

At a distance of approx. 1 km east of the Baltic Power OWF Area, a wreck is located, which has the status of a war grave – MS Wilhelm Gustloff. Pursuant to the Disposition no. 9 of the Director of the Maritime Office in Gdynia of 23 May 2006 on the ban on divining at shipwrecks – war graves (Official Journal of the Pomeranian Voivodeship of 2006, No. 26, item 1277) to protect its property against looting, as well as to protect the marine environment, it is forbidden to dive within a radius of 500 m from the location of the shipwreck.

During geophysical surveys conducted in 2019 in the Baltic Power OWF Area, the presence of 5 shipwrecks, including 2, which had been previously identified and 3 so far unidentified, was confirmed. The newly found wrecks, in accordance with the applicable laws, were reported as potential objects of underwater cultural heritage to the Pomeranian Provincial Monument Conservator in Gdańsk, the Maritime Office in Słupsk and the Hydrographic Office of the Polish Navy. Until the submission of this EIA Report, the conservation services have not made any decision whether the shipwrecks reported shall be subject to any special protection. The Applicant assumes that if these wrecks are subject to special protection, in places of their location and in the direct special avoidance procedure zones, no operations related to the construction and exploitation of the Baltic Power OWF shall be conducted.

3.9 Usage and development of the sea area and material goods

3.9.1 Shipping

The Baltic Power OWF Area is characterised by a low degree of use for the purposes of navigation (Figure 3.18).

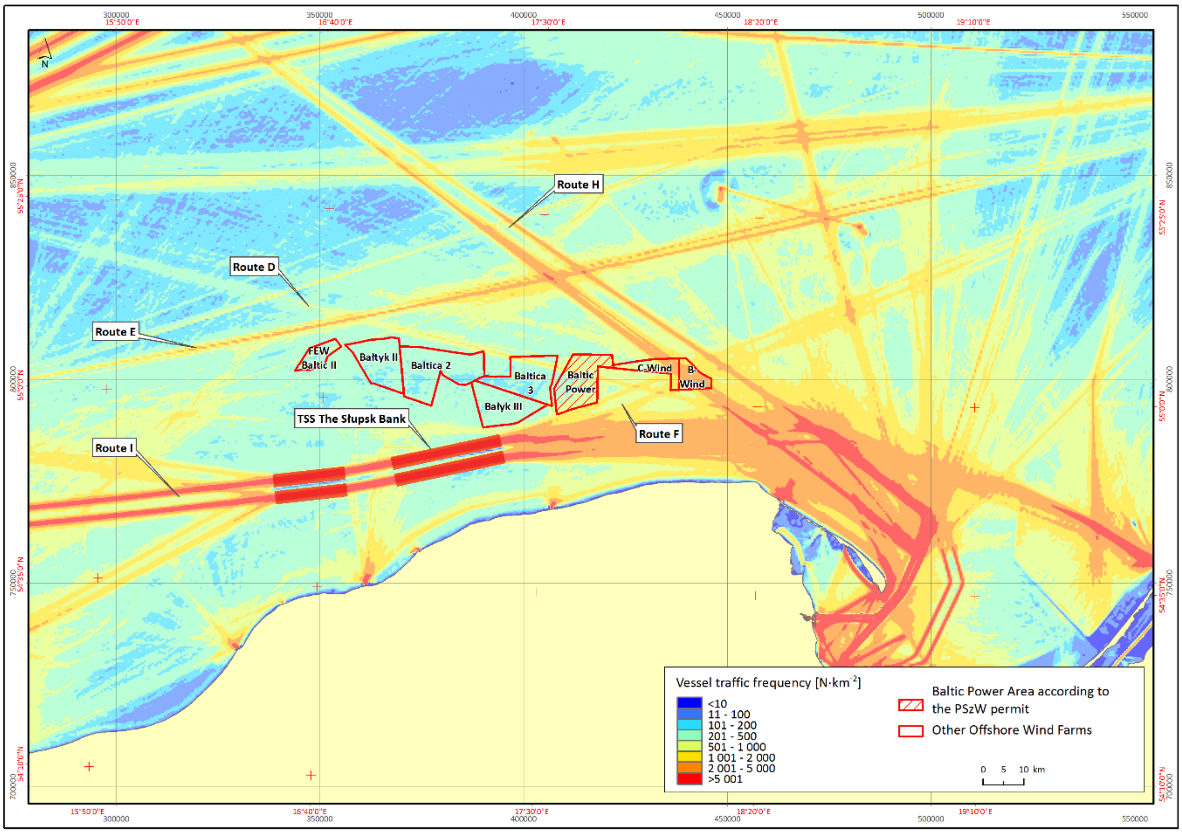


Figure 3.18. Shipping routes around the Baltic Power OWF Area, red – sections of routes, the possible modification of which requires international agreements and an approval by the IMO [Source: internal materials based on AIS data]

Currently, a regular shipping route runs across the Baltic Power OWF Area, which connects the ports of the Bay of Gdańsk with the Bornholm Strait, used primarily by tankers and merchant vessels (bulk carriers) (Figure 3.18). In 2013, 398 vessels (merchant – 53%, tankers – 17.5%, other – 22%) used this route [470]. The AIS data demonstrate that in the years 2018–2019 vessels travelled approx. 600 times using this route across the OWF Area. For many years, this route has been an element of the deep-water D route of strategic significance (for large tankers and LNG carriers) planned by the Polish maritime administration. Due to the location decisions for the construction of the OWF (PSzW), the Maritime Office in Gdynia has modified this route, as part of the work on the project of the Spatial Development Plan for the PMA at a scale of 1:200 000. The route, after the SDPPMA is approved, will bypass the Baltic Power OWF Area from the east. As a result of the change, the route will be slightly extended, which will translate to some degree into negative phenomena proportional to the change in its length, i.e. increase of costs and prolonged shipping time, increased emissions (CO_2, CO, SO_2, NO_x), increased probability of breakdown and accidents (with the assumption that the probability is proportional to the route travelled).

South of the Baltic Power OWF Area, there is a second most intensively travelled regular shipping route leading from the Danish straits to the Polish and Russian ports of the Southern Baltic. In 2013, 6686 vessels (16.7% – tankers, 44.4% – merchant, 1% – passenger, special – 6.7% and other – 30.6%) used this route [470]. The AIS data demonstrate that in the years 2018–2019 vessels travelled approx. 16 000 times using this route. There is a vessel traffic separation scheme binding on this route, which is based on two sections – Łeba–Rowy and Ustka–Jarosławiec – called the TSS Słupska Bank.

North of the Baltic Power OWF Area, there is a regular shipping route connecting Klaipeda with the ports of the Southern Baltic – mainly in Świnoujście and Sassnitz-Mukran. It is mostly used by cargo-train ferries (Mukran–Klaipeda) and cargo ships. In 2013, 893 vessels (1.5% – tankers, 38.5% – merchant, 1% – passenger, high-speed crafts – 23% and other – 32%) used this route [470]. The AIS data demonstrate that in the years 2018–2019 vessels travelled approx. 1700 times using this route. The Baltic Power OWF Area is used to a small extent by recreational vessels.

3.9.2 Fishing

Activity related to the fishing industry is carried out in the Baltic Power OWF Area. This activity was characterised on the basis of the data collected as part of the National Fisheries Data Collection Programme (NFDCP), based on the source data derived from the catch reports of fishing boats taking into account the location of catches (fishing square or geographical position), fish species, month of catches and type of vessel (vessels with a length of up to 12 m and exceeding 12 m).

The criterion of 12 m was assumed to differentiate between the vessels, which can be classified as vessels of coastal fisheries in accordance with the provisions of the Council Regulation (EC) No. 1198/2006 of 27 July 2006 on the European Fisheries Fund. The data from the catch reports may differ from the landing (final) data, however, adopting them as a basis was necessary for implementing a geographical distribution of the fishing activity. Any possible differences are insignificant and do not affect the conclusions reached. The analysis includes a review of the catch data from the years 2014–2018. The value of catches was estimated on the basis of the average annual prices of the first sale of individual species of fish and the volume of catches. Since more detailed data on the catches of the fishing fleet are available for the fishing square areas (surface area of approx. 400 km^2) that do not coincide with the OWF Area, the following was taken into consideration to determine, with the greatest possibly accuracy, the impact of the project within the area of the OWF itself (Development Area specified in the PSzW no. MFW/6/12 as amended):

- for fishing boats exceeding 12 m in length, equipped with a Vessel Monitoring System (VMS), the daily catch volume was assigned to a particular fishing square or the OWF Area on the basis of the proportion of the number of vessel position reports provided within a particular fishing square or in the OWF Area to the general number of VMS reports within a day;
- for fishing boats up to 12 m in length, for which VMS data are not available, information on the catches in the area of the Baltic square were used, while, the estimation of the catch volume in the OWF Area was carried out taking into consideration the relative share of the area covered by the OWF compared to the total surface area of the fishing square. With this simplification, the possible diversification of the catch volumes within a particular fishing square (for example, due to the differences in depth or type of seabed) is omitted, however, it is the only one possible enabling more precise reference to the location of the fish caught.

The Baltic Power OWF Area is located unevenly within the four fishing squares: N8, O8, N7 and O7 (Figure 3.19, Table 3.26).

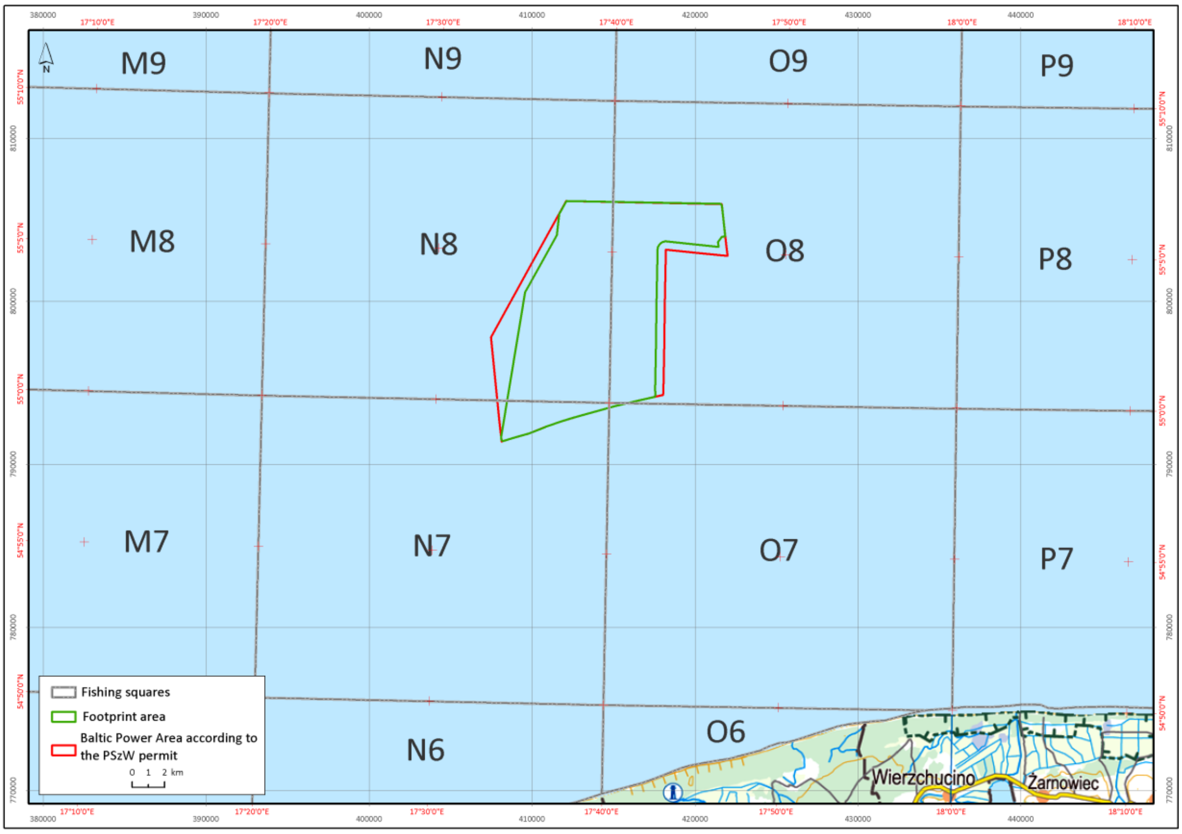


Figure 3.19. Location of the Baltic Power OWF Area against the background of fishing squares

Table 3.26. Surface area covered by the Baltic Power OWF Area (1 NM) in individual fishing squares used in calculations of catch volumes of vessels with a length of up to 12 m

Fishing square	Fishing square surface covered by the OWF Area (1 NM) [%]
N8	17.93
O8	12.89
N7	2.37
O7	0.04
Total	8.29

3.9.2.1 Volume and value of fish catches

The total volume of fish catches in the area of the four squares analysed amounted to approx. 133 tonnes in 2018, which constituted only 0.1% of the total volume of the Polish Baltic catches carried out by the Polish fishery that year. In 2018, the Polish fishing fleet conducted catches within 121 Baltic squares located in the Polish economic zone and within 99 squares outside that zone. The value of catches amounted to approx. PLN 587 000, which accounted for 0.3% of the total value of landings from Polish catches in the Baltic Sea. The average multi-annual volume and value of the share of catches from the area of four fishing squares in total Baltic Sea catches in the years 2014–2018 was 0.2% and 0.4% respectively. In the years 2014–2018, the estimated volume of catches (for the vessels with a length up to 12 m – calculated on the basis of the proportion of the surface area covered by the OWF in each fishing square and on the basis of the VMS data – for vessels with a length of more than or equal to 12 m) carried out in the OWF Area was on average 10.5 t with a value of PLN 54 000.

The vessels registered in the ports nearest to the area analysed have the highest share of volume and value of catches conducted in the area of four fishing squares analysed in relation to the total catches in the Baltic Sea. In the years 2014–2018, those were mainly the vessels registered in Łeba and Ustka.

The area of the squares analysed is characterised by a low fishing productivity. In the years 2014–2018, the average volume of catches per km^2 carried out in the area of the four fishing squares was 170 kg with a value of PLN 580. This constituted only 6% (13% – in terms of value) of the average PMA productivity, which was 2.9 $t \cdot km^{-2}$ with a value of PLN 4.6 $thousand \cdot km^{-2}$ in the years analysed. The highest productivity was recorded in the area of the O8 square, in which a small (12.9%), north-eastern part of the OWF Area is located, which was followed by lower productivity values in squares N7, O7 and N8. Of the 123 Baltic squares situated in the PMA (partially or entirely), the O7 square occupied a distant 93^{th} position in terms of catch volume per km^2 of the surface area.

The average share of fish caught in the years 2014–2018 in the area of squares located in the region of the planned project in relation to the total Polish catches in the Baltic Sea was minimal and equalled 0.2%, and for the surface area of the OWF itself was close to zero (0.01%). Analysing the relative significance of the area of fishing squares, which are to be partially occupied by the OWF Area, as the location of catches for fishing boats registered in various ports, it can be seen that it plays a noticeable role only for the boats registered in Łeba (4.2%) (Table 3.27). For the boats registered in other ports, catches conducted in the area of the four squares analysed can be considered negligible, their relative volume did not exceed 1% for any of the squares (on average in the years 2014–2018). The area analysed was of similar low significance in terms of value in the years 2014–2018. The significance of the four squares analysed was noticeable (7.5%) only for the vessels registered in Łeba. In the case of vessels registered in other ports, the share of catch value for the area of the N8, N7, O8 and O7 squares in the total catches did not exceed 1% (Table 3.28).

Table 3.27. Average volume [t] of catches in fishing squares N8, N7, O8, O7 in the years 2014–2018, in reference to the average value of the Polish catches in the Baltic Sea as divided into fishing boat registration ports and their sizes [Source: data from the National Fisheries Data Collection Pogramme]

Port	Fishing squares N8, N7, O8, O7			Baltic Power OWF Area			The Baltic Sea	Percentage share [%]	
	<12 m	>12 m	In total	<12 m	>12 m	In total		In the fishing squares	In the OWF Area
Łeba	12.4	91.4	103.8	0.9	3.2	4.1	2478.7	4.2	0.2
Władysławowo	0.0	76.9	76.9	0.0	0.0	0.0	16 159.1	0.5	0.0
Ustka	16.6	25.7	42.3	2.7	1.9	4.6	42 287.0	0.1	0.0
Dziwnów	32.5	0.0	32.5	0.1	0.0	0.1	5664.1	0.6	0.0
Świnoujście	4.1	2.9	7.0	0.7	0.0	0.7	4019.2	0.2	0.0
Hel	0.4	1.9	2.2	0.1	0.0	0.1	35 912.9	0.0	0.0
Kołobrzeg	0.5	1.8	2.3	0.1	0.1	0.2	11 645.6	0.0	0.0
Darłowo	2.8	0.2	2.9	0.0	0.0	0.0	951.3	0.3	0.0
Other	1.8	0.0	1.8	0.8	0.0	0.8	18 299.7	0.0	0.0
Total	71.0	200.7	271.7	5.2	5.3	10.5	137 417.9	0.2	0.01

Table 3.28. Average value [in thousands of PLN] of catches in fishing squares (N8, N7, O8, O7) and in the Baltic Power OWF Area in the years 2014–2018 in reference to the average value of the Polish catches in the Baltic Sea as divided into fishing boat registration ports and their sizes [Source: data from the National Fisheries Data Collection Programme]

Port	Fishing squares N8, N7, O8, O7			Baltic Power OWF Area			The Baltic Sea	Percentage share [%]	
	<12 m	>12 m	In total	<12 m	>12 m	In total		In the fishing squares	In the OWF Area
Łeba	38.0	356.5	394.5	2.2	12.8	15.0	5274.4	7.5	0.3
Ustka	93.0	156.8	249.8	14.6	17.8	32.5	25 905.1	1.0	0.1
Władysławowo	0.0	111.0	111.0	0.0	0.0	0.0	51 773.3	0.2	0.0
Dziwnów	105.6	0.0	105.6	2.7	0.0	2.7	7913.4	1.3	0.0
Świnoujście	11.7	6.9	18.7	1.9	0.2	2.0	6609.9	0.3	0.0
Darłowo	2.4	9.4	11.8	0.4	0.4	0.8	48 067.6	0.0	0.0
Kołobrzeg	6.6	0.7	7.3	0.3	0.0	0.3	13 330.5	0.1	0.0
Hel	2.3	3.7	6.0	0.3	0.0	0.3	3723.5	0.2	0.0
Other	10.5	0.1	10.6	0.1	0.0	0.1	43 466.9	0.0	0.0
Total	**269.9**	**645.2**	**915.1**	**22.6**	**31.2**	**53.8**	**206 064.6**	**0.4**	**0.03**

The volume and value of fish catches in individual fishing squares, in which the OWF Area is located, is diversified. As can be seen in Figure (Figure 3.20), the volume of catches in the squares analysed has been changing throughout the years, with a visible downward trend. This was due mainly to the deteriorating state of cod stocks, particularly evident in the coastal zone.

Figure 3.20. Volume [t] and value [PLN] of the catches carried out in the fishing squares N8, N7, O8, O7 [Source: data from the National Fisheries Data Collection Programme]

The main fish species caught within the six squares analysed in the years 2014−2018 were cod and flounder (Table 3.29), corresponding to 40% and 28% of the total catch volume, and 56% and 12% of the value of fish caught (Figure 3.21). The remaining share was constituted by other fish, among which herrings, sprats, sea trouts and turbots dominated.

Table 3.29. Volume and value of fish catches in the fishing squares: N8, N7, O8, O7 in the years 2014–2018, divided into more significant species [Source: data from the National Fisheries Data Collection Programme]

Species	**Catch parameter**	**Year**				
		2014	**2015**	**2016**	**2017**	**2018**
Flounder *Platichthys flesus*	Volume [t]	126.7	75.0	56.5	50.7	62.9
	Value [in thousands of PLN]	174.5	104.9	75.6	82.8	101.9
Cod *Gadus morhua*	Volume [t]	141.9	199.6	85.0	74.0	45.5
	Value [in thousands of PLN]	663.3	901.5	408.4	368.0	230.3
Other*	Volume [t]	61.7	163.8	27.9	162.2	25.2
	Value [in thousands of PLN]	134.4	257.0	228.6	589.4	254.8
Total volume [t]		330.3	438.4	169.4	286.9	133.6
Total value [in thousands of PLN]		972.1	1263.4	712.6	1040.2	587.0

**Mainly herring, sprat, sea trout and turbot*

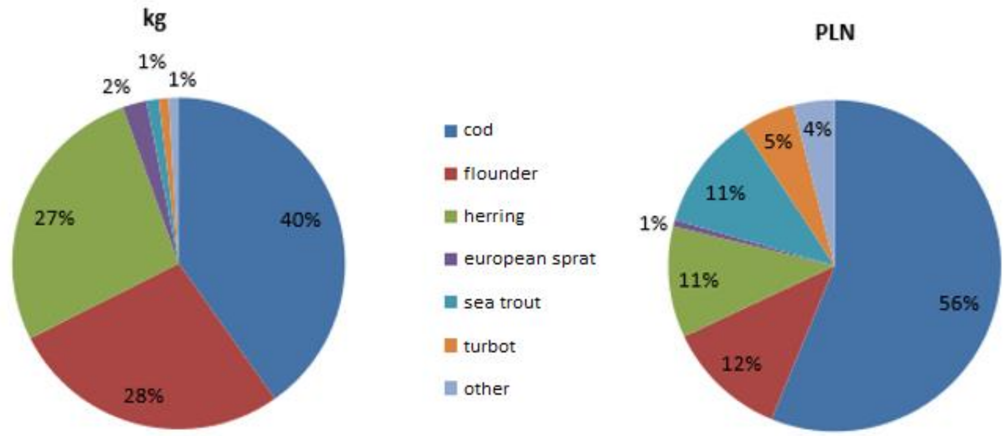


Figure 3.21. Species structure in the catches in the area of N8, N7, O8, O7 fishing squares in the years 2014–2018 [Source: data from the National Fisheries Data Collection Programme]

In the period analysed, with the exception of 2018 (which was due to the gradual transfer of cod catches by larger vessels to deeper waters), the vast majority of catches, both in terms of volume and value, were conducted by fishing boats with a total length exceeding 12 m (Table 3.30). This was due both to the prevalence of large vessels, as well as their higher fishing capacity. In the years 2014–2018, the share in the volume and value of catches of this vessel group was 74% and 71% respectively.

Table 3.30. Volume and value of catches in N8, N7, O8, O7 fishing squares in the years 2014–2018, as divided into fishing boat lengths [Source: data from the National Fisheries Data Collection Programme]

Catch parameter	Vessel group by length [m]	Year				
		2014	2015	2016	2017	2018
Volume [t]	<12	100.0	81.3	42.4	65.8	65.3
	≥12	230.3	357.1	126.9	221.1	68.3
Value [in thousands of PLN]	<12	284.4	280.1	150.0	276.0	359.0
	≥12	687.7	983.3	562.6	764.3	228.1
Total volume [t]		330.3	438.4	169.4	286.9	133.6
Total value [in thousands of PLN]		972.1	1263.4	712.6	1040.2	587.0

The substantial decrease in the catches in 2018, especially for vessels exceeding 12 metres in length, had two causes. The first one was a significant reduction of cod catches conducted in the area analysed (which also took place in other regions of the Baltic Sea) and concerned mainly vessels registered in Łeba. Decrease in catches was also caused by the reduced catches of herring, which was purely coincidental, since one of the pelagic boats was not active that particular year.

The calculation results for catch volumes in individual fishing squares and values of catches conducted in the OWF Area are presented in the table (Table 3.31). As has been mentioned before, the value of catches in the OWF Area for vessels exceeding 12 m in length was calculated proportionally to surface area, which will be covered by the OWF Area (the area specified in the permit PSzW No. MFW/6/12 as amended including the buffer zone with a width of 500 m) in a particular fishing square. Whereas, for the vessels with a length exceeding or equal to 12 m, the value of catches in the OWF Area was calculated on the basis of the VMS records. In 2018, the estimated value of fish caught in the OWF Area was approx. PLN 31 000. Catches of the highest value were carried out in 2017 (PLN 83 000).

Table 3.31. Value of catches in the N8, N7, O8, O7 fishing squares in the years 2014–2018 and the estimated value of catches in the Baltic Power OWF Area [Source: data from the National Fisheries Data Collection Programme]

Vessel group by length [m]	**Fishing square**	**Value of catches in the fishing squares [in thousands of PLN]**					**Estimated value of catches in the Baltic Power OWF Area [in thousands of PLN]**				
		2014	**2015**	**2016**	**2017**	**2018**	**2014**	**2015**	**2016**	**2017**	**2018**
<12	N8	71.0	145.9	36.5	76.5	44.4	12.7	26.2	6.5	13.7	8.0
	O8	76.0	12.9	2.6	34.3	111.3	9.8	1.7	0.3	4.4	14.4
	N7	123.4	103.6	104.5	158.1	150.2	2.9	2.5	2.5	3.7	3.6
	O7	14.0	17.8	6.4	7.0	53.0	0.0	0.0	0.0	0.0	0.0
	Total	**284.4**	**280.1**	**150.0**	**276.0**	**359.0**	**25.5**	**30.3**	**9.4**	**21.9**	**25.9**
≥12	N8	74.6	63.5	115.4	173.4	12.2	5.4	16.0	23.0	29.6	3.5
	O8	163.6	370.0	116.7	340.1	48.6	13.4	10.2	7.5	27.0	1.6
	N7	166.6	204.8	136.1	113.0	76.2	3.7	4.5	6.4	4.1	0.0
	O7	283.0	345.0	194.4	137.8	91.2	0.0	0.0	0.0	0.0	0.0
	Total	**687.7**	**983.3**	**562.6**	**764.3**	**228.1**	**22.5**	**30.7**	**36.9**	**60.7**	**5.1**
Total		972.1	1263.4	712.6	1040.2	587.0	48.0	61.0	46.3	82.6	31.0

The analysis of the fish catch monthly variability in the OWF Area demonstrates a concentration of the fishing fleet mainly in the autumn season (September–December) (Figure 3.22). In the years 2014–2018, 50% of the catch value (PLN 2.3 m) was from those months, out of which 70% (PLN 1.7 m) were cod catches. Due to the protection of cod, the lowest catches in the region analysed were in the summer season (June–August). In the years 2014–2018, as little as 14% of the annual catch value was from that period.

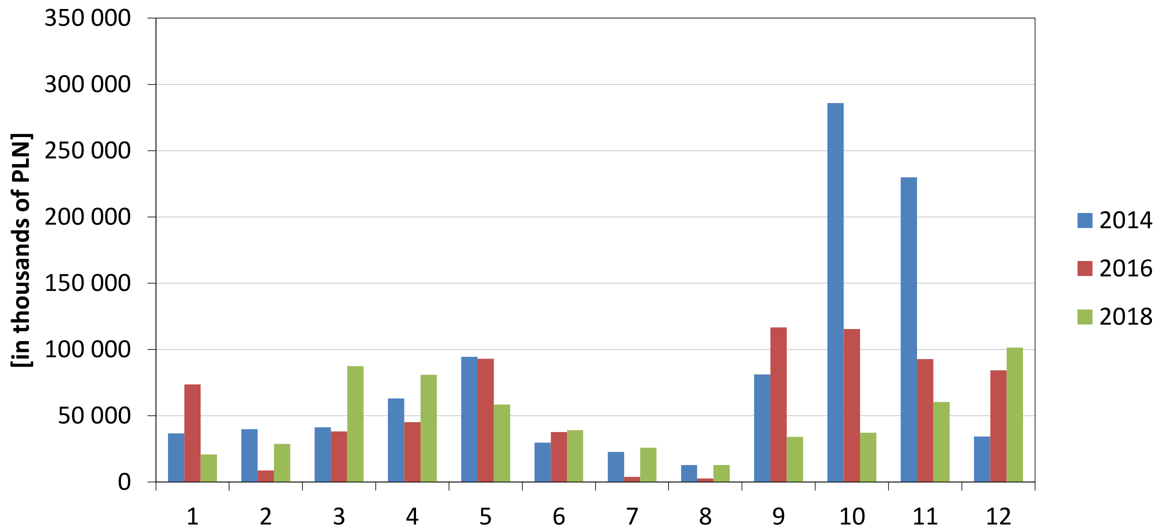


Figure 3.22. Monthly value of catches [in thousands of PLN] in the area of the N8, N7, O8, O7 fishing squares in the years 2014, 2016 and 2018 [Source: data from the National Fisheries Data Collection Programme]

In the catches conducted in the OWF Area in the years 2014–2018, mostly set gear (gillnets and longlines) was used, followed by bottom trawls and pelagic trawls. Fixed gear (mainly cod gillnets) had a 50% share in the total catch volume from the area of the four fishing squares. While, the share of the bottom trawl catches was 21%. The use of set gear within the squares covered by the OWF Area was systematically decreasing in the years 2014–2018, while in the case of bottom and pelagic trawls it varied (Figure 3.23). Both types of gear are used for catching cod, which explains fully the changes observed. However, as mentioned above, the fishing performance of vessel fishing with the use of pelagic trawls should be considered as largely random and dependent on the activity of individual fishing boats in the area analysed.

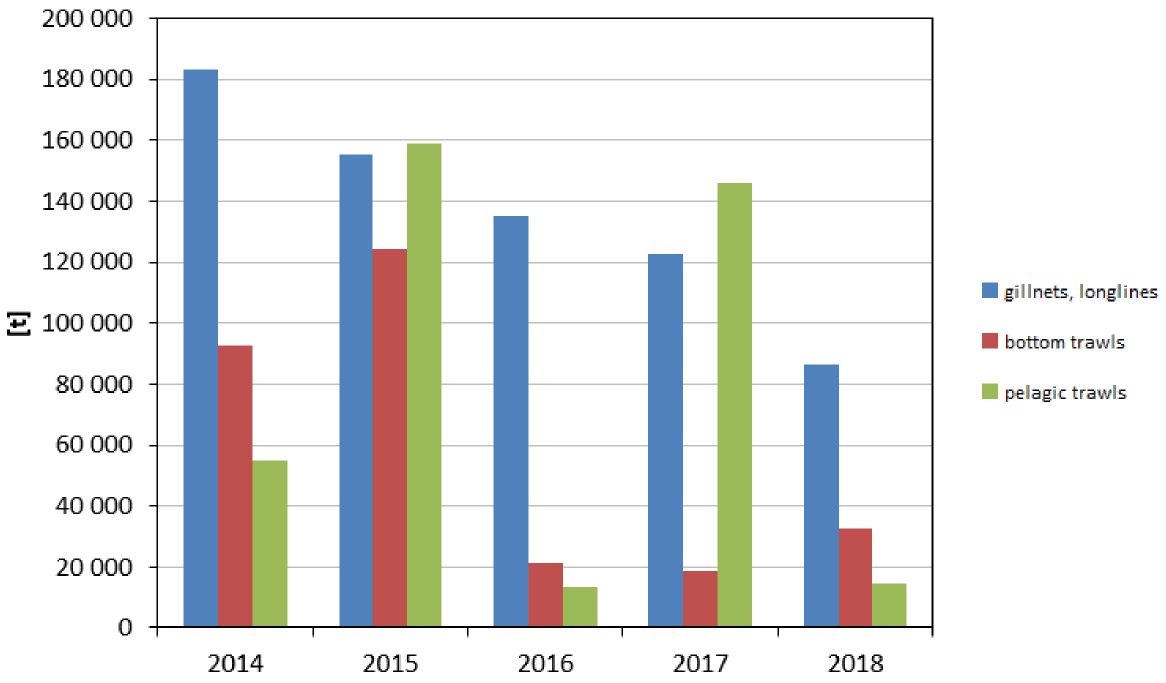


Figure 3.23. Volume of catches conducted using particular type of fishing gear in the area of the N8, N7, O8, O7 fishing squares in the years 2014–2018 [Source: data from the National Fisheries Data Collection Programme]

The seasonality of fishing was mainly influenced by the activity of larger fishing boats, with a total length exceeding 12 m, which was particularly evident in the autumn-winter season (Figure 3.24). The catches of vessels with a total length of up to 12 m indicated lower monthly variation, although with a visible increase in catch volumes in the spring period, March–June.

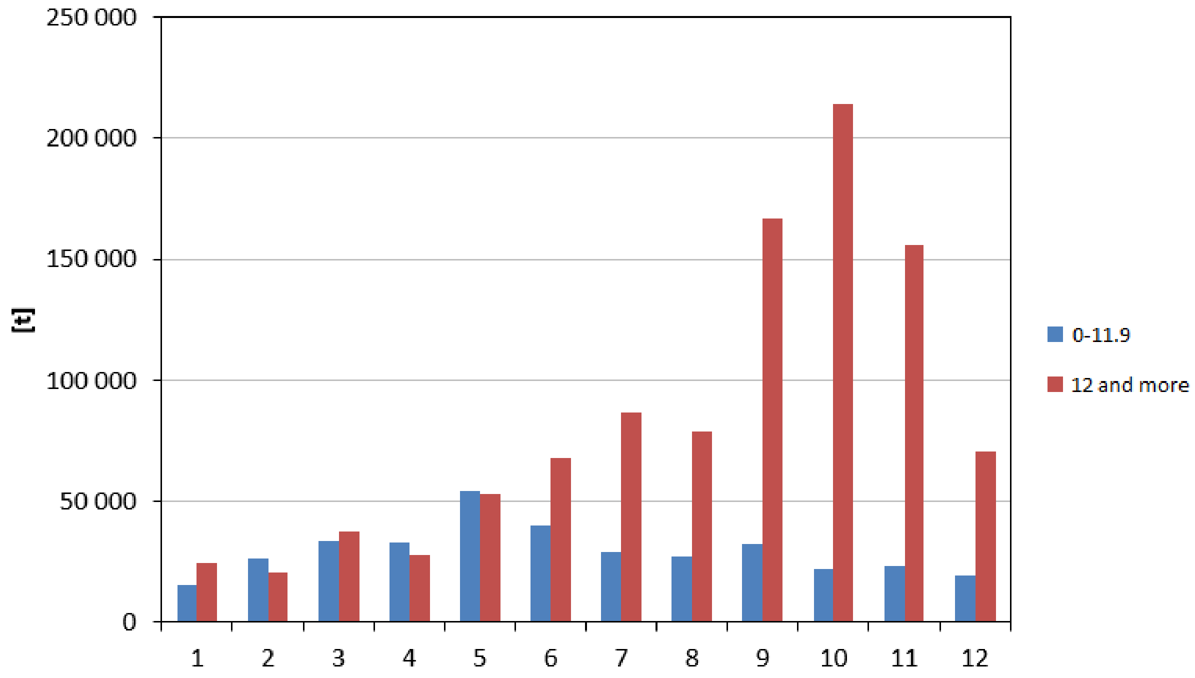
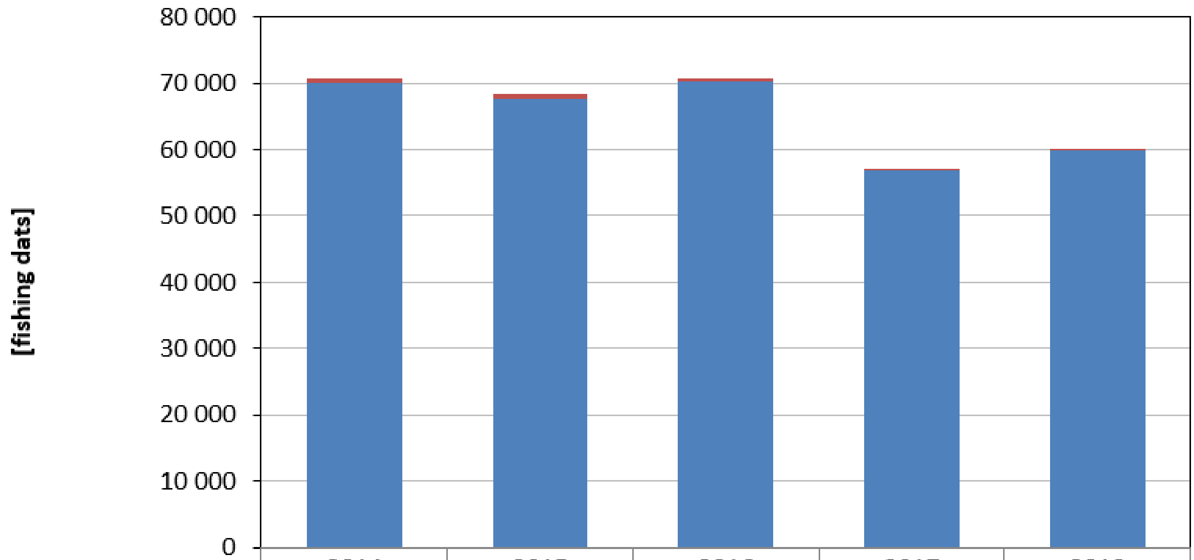


Figure 3.24. Volume of catches in the area of N8, N7, O8, O7 fishing squares in the years 2014–2018, as divided into fishing boat types regarding their length [Source: data from the National Fisheries Data Collection Programme]

3.9.2.2 Size of fishing effort

In the years 2014–2018, fish catches were reported in the area of the N8, N7, O8, O7 fishing squares by 56, 59, 42, 56 and 54 vessels respectively, compared to a total of 799, 767, 779, 751 and 736 active fishing vessels conducting catches in the Baltic Sea. Fishing vessels with a length exceeding 12 m prevailed, with an average of 70% share in the entire period analysed; 40, 49, 34, 37, 30 vessels respectively in the years 2014–2018.

In the years 2014–2018, the total fishing effort (measured by the number of fishing days) in the area of the four squares equalled from 644 days in 2015 to 314 days in 2018 (Figure 3.25). The most visited square was the O7 square (250 days in 2014 and 267 days in 2015), followed by N7 (254 days in 2015). The relative significance of the area of the four squares analysed in the total fishing effort of the Polish fishing fleet conducting catches in 2018 in the Baltic Sea (60.1 thousand days) was negligible and equalled 0.5%.



	2014	2015	2016	2017	2018
Baltic Power OWF	621	644	369	461	314
others	70 039	67 690	70 254	56 696	59 847

Figure 3.25. Number of fishing days in the area of the N8, N7, O8, O7 fishing squares in the years 2014–2018 and the remaining fishing regions of the Baltic Sea [Source: data from the National Fisheries Data Collection Programme]

3.9.3 Other developments

There are no structures permanently fixed to the seabed in the OWF Area. There are also no licenses issued for the prospection, exploration and production of hydrocarbons from subsea deposits. The prospection–exploration licenses applicable for this area a few years ago expired in 2016 and until the date of the submission of this EIA Report have not been renewed. The applications submitted for the SDPPMA project also do not concern the Baltic Power OWF Area.

3.10 Landscape, including the cultural landscape

The location of the Baltic Power OWF covers an area situated approx. 22 to 34 km away from the land. The landscape varies depending on the weather conditions – during calm days the sea is calm and monotonous, while with the increased wind strength, reduced insolation and increased cloudiness and humidity, including precipitation, the sea state, wave motion and air transparency also change. Water vapour hangs above the water, which further reduces visibility, thus making it difficult for the observer to determine the point of contact of the sea and the sky on the horizon.

Land is visible rarely from the Baltic Power OWF Area.

People are rarely present in the Baltic Power OWF Area. Important regular and planned shipping routes run across the Baltic Power OWF Area (Figure 3.26) and within its region at a distance of from several to several dozen kilometres. The routes are used by oil carriers, container ships, cargo and train ferries, as well as passenger ferries, passenger and cargo ships, freighters, tankers and other. A proposed new north-eastern shipping route corridor runs north of the Baltic Power OWF Area, however, it has not been established yet. Additionally, the SDPPMA project also foresees that part of the shipping will be redirected from the southern to the northern side of the Baltic Power OWF Area.

The Baltic Power OWF is located in parts of the four fishing squares and the movement of fishing boats takes place there (Figure 3.19). Other closest forms of land development are the areas subject to concessions for prospecting and identification of crude oil and natural gas deposits, and the nearest oil rig Baltic-Beta is located at a distance of more than 50 km, i.e. outside the scope of visibility from the Baltic Power OWF (Figure 3.26).

It was estimated that in the years 2018–2019 within a 50 km zone from the OWF Area, there were more than 200 vessels present daily, which remain in the zone of the OWF visibility from aboard a vessel (which is approx. 50 km) for up to several hours.

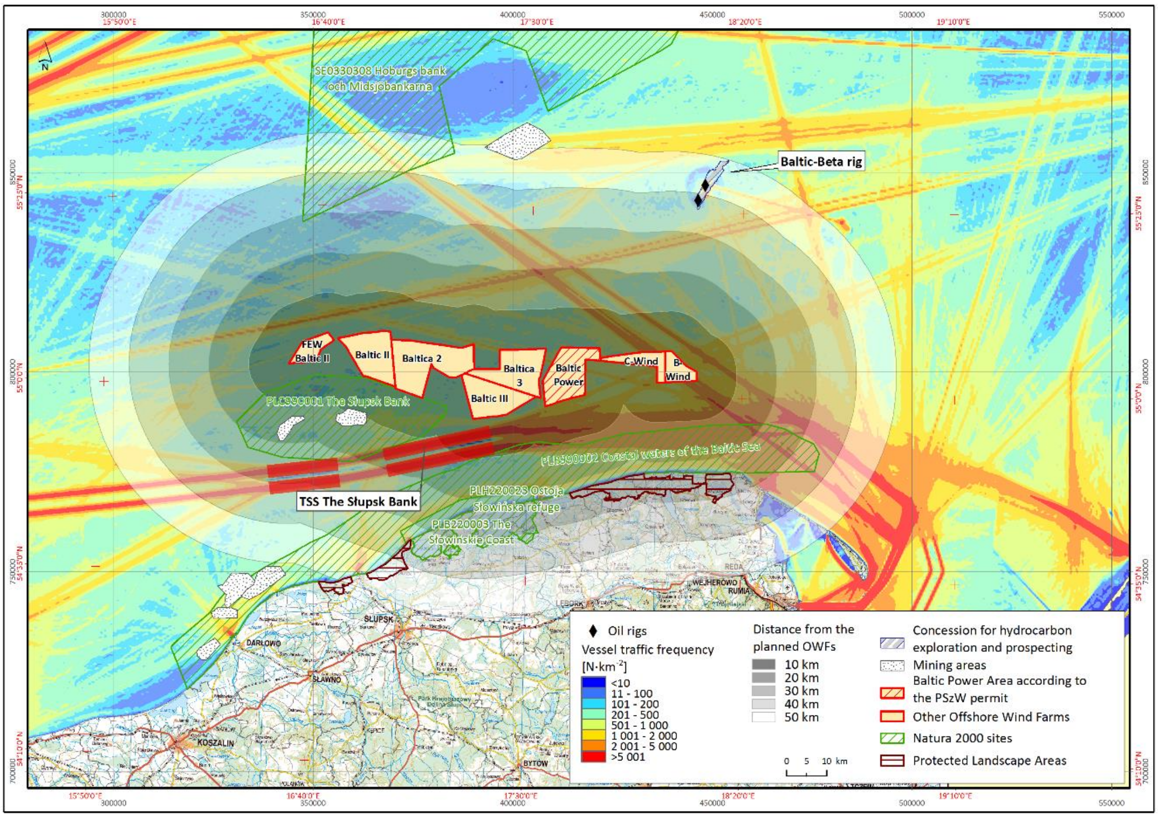


Figure 3.26. Development and use of the surrounding sea area; red – sections of routes, the possible modification of which requires international agreements and an approval of the OWF Area by the IMO [Source: internal materials]

The marine cultural landscape includes the anthropogenic development and use of both the sea and the seabed, which is available only to divers and the operators of underwater vehicles. The Baltic Sea landscape is not subject to classification, and only for the BALANCE project "Baltic Sea Management – Nature Conservation and Sustainable Development of the Ecosystem through Spatial Planning" (2005–2007) a concept of submarine landscapes has been developed. In the Baltic Power OWF Area and within its region, there are no fixed elements of land development.

Within the zone range of the potential impact of the OWF on the landscape, there is an area of land along a section from Ustka in the west to Jastrzębia Góra in the east. Due to the shape of the coastal zone, the Baltic Power OWF can be seen from the beaches along this section. According to the physico-geographical division of Poland [226], this is the Słowińskie Coast, which constitutes a narrow strip of land along the shore of the Baltic Sea. This area is characterised by a post-glacial relief. Dune embankments are present here with a height from a few to several dozen meters above sea level, overgrown with forest, obscuring the view of the sea, as well as swamps and wetlands, and coastal lakes with sandbars from the sea side. The landscape is diversified with narrow valleys of watercourses debouching into the sea. Various protected areas, including landscape protection areas located within them, are present here. These are: the Protected Landscape Area "Coastal Belt west of Ustka", the nature and landscape complex "Ostoja Łabędzi" in Ustka, the Protected Landscape Area "Coastal Belt east of Ustka", the Słowiński National Park, the "Sarbska Spit" Landscape Reserve, the Coastal Protected Landscape Area, the Polish Coastal Landscape Park. In exceptional weather conditions, the Baltic Power OWF will be potentially visible along the section discussed from the elevated observation points: the Czołpino lighthouse, dunes in the Słowiński National Park, the Stilo lighthouse and the towns of Ustka, Rowy, Łeba and Jastrzębia Góra.

3.11 Population and living conditions of people

The population of the coastal districts in the Pomeranian Voivodeship, in the immediate vicinity of the Baltic Power OWF Area, is characterised by a low birthrate and a high positive migration balance. In the majority of the coastal municipalities such as Ustka (town and municipality), Smołdzino, Łeba, Wicko and Krokowa, the complexes of onshore wind power stations already exist or are planned, due to, among other things, very favourable wind conditions. Coastal areas are characterised by multiple tourist and recreational values, including those related to the use of the sea. They are the basis for the income of a significant number of residents. This applies, for example, to fishery, maritime tourism, water sports and other human activities related to the immediate proximity of the sea.

The Baltic Power OWF Area was subject to the prospection and periodic exploitation of aggregate deposits. The exploration and prospection of subsea hydrocarbon deposits have also been conducted in these areas.

The theoretically determined centre of the Baltic Power OWF is located in the following distances from the nearest ports:

- Łeba – 32 km;
- Władysławowo – 57 km;
- Ustka – 72.5 km;
- Darłowo – 106.5 km.

Due to the size of the transportation vessels and vessels used for the construction of the OWF, the back-up facilities for the construction and decommissioning of the Baltic Power OWF can be potentially located in the ports of Gdańsk and Gdynia which are 130 km away from the OWF. At the moment, another location for an installation or service port cannot be excluded, but it may also be located in one of the foreign ports. The selection of the location for the installation and service port is influenced by many factors and is not the subject-matter of this analysis.

The OWF Area is located partly in the area of important, commonly used and planned shipping routes and fishery routes. Their significance for the Baltic Sea navigation is evidenced by the number of nearly 400 vessels, which used the Baltic Power OWF Area in 2019.

The Baltic Power OWF Area is a place of fishing activity. This area is situated in parts of the four fishing squares: O7, O8, N7 and N8. The issues related to fishery are described in detail in the subsection 3.9.2.

To conclude, it should be emphasised that the Baltic Power OWF Area is of small significance to the commercial and recreational navigation, as well as fishery.

4 Modelling performed for the purposes of the project impact assessment

For the purposes of this EIA Report, modelling was carried out in order to:

- obtain information on the extent of the suspended solids dispersion and their concentration in the water as a result of the work conducted that disturb the seabed sediments (Appendix 2 to the EIA Report);
- obtain information on the range and intensity of the underwater noise generated during installation and construction works (Appendix 3 to the EIA Report);
- obtain information on the potential number of collisions of passing seabirds with wind power stations (Appendix 4 to the EIA Report).

Moreover, based on the results of seabird inventory, the modelling of their density in the areas surveyed was performed. The results of this modelling are presented in Appendix 1 to the EIA Report.

The methods of the modelling of suspended solids dispersion, underwater noise propagation, collisions with wind power stations as well as the conclusions of this modelling are briefly described below.

4.1 Modelling of suspended solids dispersion and concentration

The source of suspended solids in the water are the works related to the preparation of the seabed for the foundation of the OWF structural elements and the burying of power and telecommunication cables. The content of the suspended solids depends, among others, on the water depth, types of seabed sediments and dimensions of the supporting structures installed.

The numerical model applied takes into account the transport of suspended solids in a dynamic marine environment during the conduct of underwater and dredging work on the seabed in the area intended for the Baltic Power OWF project.

Performing calculations which take into account various forcing conditions (wind, currents) enabled the analysis of the effect of these conditions on specific parameters of the suspended solids impact. The method of performing the calculations enabled the selection of the least beneficial impacts for the environment, i.e. the suspended solids impacts caused by the work related to the construction of the wind farm, which interfere with the marine environment the most. The results of the simulations performed lead to the following conclusions:

- during the weakest environmental forcings, at the lowest wind speeds generating the lowest current velocities (in the order of a few $cm \cdot s^{-1}$) and, additionally, with the circulating nature of currents with low velocities, the highest suspended solids contents occur;
- the greatest extent of the suspended solids impact occur at moderate winds, the direction of which is constant during the conduct of operations related to the preparation of the seabed for a supporting structure;
- higher suspended solids contents (from a dozen to several dozen $mg \cdot l^{-1}$) have a local range in relation to the place of the dredging work performance and do not exceed a distance of 1200 m;
- avoidance of the cumulative impact related to the increase in the suspended solids content during simultaneously conducted preparatory work for two supporting structures is easy to implement by introducing a restriction of the possibility of simultaneous operation on adjacent power stations;

- the cumulative effect does not refer to the increase in the suspended solids content for different types of underwater work, since the times of the different activities causing the sediment to be suspended in the water column and the periods of their suspension do not overlap;
- the greatest thickness of the newly formed sediments in the least favourable scenarios (current systems, work carried out in cohesive soils in shallower waters), at a distance of 100 m from the work site, do not exceed the value of 24 mm in the case of work related to the preparation for the foundation or supporting structure and 8 mm in the case of laying power and telecommunication cables;
- the thickness of the newly formed sediments at a distance of 1000 m from the site of the work carried out do not exceed 5 mm;
- the effect of accumulation of the newly formed sediments caused by various anthropogenic activities during the construction phase (preparatory work for foundations or supporting structures and cable burying) is possible, however, cumulative impacts will be local and short-termed. Natural processes of sediment re-suspension caused by storm phenomena (increase in near-seabed currents) will be responsible for the changes in the thickness of sediments in the Baltic Power OWF Area and outside of it during the wind farm exploitation phase;
- moreover, in the least favourable scenario, the average thickness value of the sediment formed due to the work related to the preparation of the seabed for structures will not exceed 1.4 mm in APV and 1.3 mm in RAV within the entire Baltic Power OWF Area; the sediments mobilised will be natural and local;
- the impact of suspended solids on the marine environment in the least favourable scenario does not exceed 64 hours from the beginning of work in the seabed on a single foundation (this condition is determined by the moment of reaching the negligible concentration, lower than 2 $mg \cdot dm^{-1}$);
- the dredging works conducted simultaneously in two locations 3 km apart, on the foundation of supporting structures, do not affect each other in terms of suspended solids interaction in the case of work conducted in non-cohesive soils and have a minimal effect in the case of cohesive soils.

4.2 Modelling of underwater noise propagation

Underwater noise will be emitted to the environment at each stage of the Baltic Power OWF implementation. However, its greatest impact is expected during construction due to the high level of noise generated during pile driving. Many marine organisms can be sensitive to underwater noise (particularly fish and marine mammals) which propagates over long distances in the water. Bathymetric and hydrological conditions have a decisive influence on the propagation of underwater noise, therefore, the modelling took into account the local bathymetric and hydrological conditions measured during the surveys of the Baltic Power OWF Area as well as the data available for the Baltic Sea area within a radius of over 150 km.

The analysis was carried out for the most unfavourable scenario (piling of the foundation or supporting structure with a diameter of 12.5 m) using the numerical modelling of underwater noise. On the basis of the acoustic modelling, the zones of sound impact (different distances from the source of sound) on marine mammals (seals and porpoises) and fish with a swim bladder and without a swim bladder, which can be affected by the permanent threshold shift (PTS), temporary threshold shift (TTS) and behavioural response (change in behaviour), were estimated.

The sound levels were also estimated taking into consideration the NRS in the form of a big bubble curtain (BBC) placed around the site of pile driving into the seabed. The curtain generates a circle of bubbles around the pile driving site, which results in the reflection and absorption of the underwater sound, and therefore, a decrease of the level of sound generated by piling. On the basis of the available data from literature, the sound level reduction by 13 dB was adopted for the application of NRS such as the exemplary big bubble curtain (BBC).

The modelling results indicate that the propagation of sound depends on the seabed topography, which results in the differences in the directions of sound intensity. This is illustrated on numerous maps, which show the horizontal propagation of sound. It can be clearly deduced from them that sound levels are lower in the north-western, southern and south-western directions.

Additionally, due to the possibility of a situation, in which simultaneous piling will take place in a sea area in two or more locations within the adjacent OWFs, modelling was carried out to determine potential cumulation of noise and its impact on porpoises, seals and fish. On the basis of the estimations conducted, it was found that what is significant for the size of impact is the number of sources and not the distance between them.

The impact zones estimated indicate that for a single strike the hearing loss area involving a permanent threshold shift (PTS), for both the porpoise and the seal, is located at a relatively close distance from the sound source, 1.6 km and 0.1 km for the Baltic Power OWF Area, respectively. The temporary threshold shift (TTS) may occur at the distance of 9.1 km for the porpoise and 1.2 km for the seals. Up to 85.4 km from the location surveyed, changes can occur in the porpoise behaviour, whereas, up to 12.6 km – in the seal's. The behavioural criterion is based on the values which do not take into account the animal hearing sensitivity, thus, they should be treated with caution.

With the use of NRS in the form of a BBC, the impact zones for a single strike decrease significantly. The range of PTS occurrence for the porpoise and the seal decreases to the distance below 0.1 km. While the TTS may occur at the distance of up to 1.7 km for the porpoise, and of 0.1 km for seals. The behavioural response after the NRS application decreases to the distance of 15.6 km for the porpoise, and 2.9 km for seals.

The impact ranges for repeated pile driver strikes during piling are much greater than those obtained for a single strike. Assuming that animals do not relocate during 1-hour exposure to noise, impact in the form of PTS for the porpoise and the seal can be expected at the distances of 42.4 and 13.1 km respectively for the Baltic Power OWF Area. The temporary threshold shift (TTS) will occur at the distance of 129.6 km for the porpoise and 59.2 km for the seals. The use of a NRS in the form of BBC reduces significantly the impact range for repeated strikes, so that PTS ranges are less than 9.1 km and 0.8 km for the porpoise and the seal, respectively. The TTS ranges will decrease to 20 km for the porpoise and 6.1 km for the seal.

In the case of fish with a swim bladder and without a swim bladder, the same threshold values causing PTS and TTS are estimated for single pile driver strikes, which are 0.1 km and 0.4 km, respectively. However, a behavioural response should be expected at the distance of 66.8 km in fish without a swim bladder and up to 150.1 km in fish with a swim bladder. The noise reduction system (NRS) will mitigate the range of behavioural response up to 13.5 km for fish without a swim bladder and 21.6 km for fish with a swim bladder.

The estimates relating to the repeated pile driver strikes show the PTS in fish with a swim bladder and without a swim bladder at the distance of 4.6 km and 0.8 km, respectively. The values decrease after the NRS is applied to 0.6 km and 0.1 km, respectively. The occurrence of TTS extends up to 20.9 km for both types of fish and decreases to 6.3 km after the NRS is applied.

It should be taken into account that impact zones for repeated pile driver strikes during piling were estimated adopting the worst-case scenario. The current knowledge on the cumulation of sound energy in animal organisms is scarce. Moreover, there is an on-going discussion on some of the criteria used when calculating the impact zones related to repeated strikes. Therefore, the results of modelling related to a series of sounds generated as a result of repeated pile driver strikes during piling should be treated with caution.

Detailed results of the modelling of underwater noise propagation together with the description of the model and methods of its preparation are included in Appendix 2 to the EIA Report.

4.3 Modelling of the risk of bird collision

Due to their size, wind power stations, both onshore and offshore, may generate a negative impact in the form of collisions of flying birds with the components of wind power stations. This applies particularly to the moving parts of a power station, i.e. a rotor with its blades. In order to determine the collision risk expressed as a number of collisions anticipated, the basic model developed by Band was used [25]. The model assumes that a certain proportion of the flying birds' population is within the rotor range. To estimate the risk of bird collisions, quantitative data on migratory birds is required as well as the information on the parameters of individual wind power stations and the entire wind farm. It is assumed that the probability of a collision with a rotor depends on a bird's size (wingspan and wing area), blade range and angle, rotor speed and the speed of a bird's flight. In the case of the reduced visibility (low clouds, night, dense fog), birds are able to spot the OWF from a shorter distance than in good visibility conditions, which results in a higher risk of collision. During analyses both the variant proposed by the Investor and the alternative variant were tested together with the different ranges of the clearance height between the lower range of the rotor and the water surface. Among all the species considered in this analysis, the significance of the collision risk was determined at a moderate level for the common scoter and the crane. In the case of the common scoter, the maximum mortality scenario assumes a collision of up to 7 individuals per season. For the crane, the maximum mortality was estimated at around 120 individuals in the autumn in the alternative variant, while the models for the Applicant Proposed Variant indicate mortality of around 25% lower both in spring and in autumn for all clearance ranges tested. The significance of the impact such as the risk of collision for the long-tailed duck and the velvet scoter was assessed as negligible. For these species, the estimated number of collisions concerns single specimen. In the case of geese, the estimated number of collisions, in the worst-case scenario, concerned over 70 individuals due to the very large populations of species included in this category (estimated at more than 3.5 million individuals). For the remaining species, the significance of the impact was considered negligible. The estimation of the possible collisions in the case of cumulative impact was carried out by multiplying the results of the collision risk modelled by 5.75. The coefficient was calculated from the proportion of the sum of the capacity of seven OWFs (included in the cumulative impact analysis) to the capacity of the Baltic Power OWF. For most species, mortality still remains at a very low level. The cumulative impact in the case of the common scoter means a maximum of 40 individuals colliding, and in the case of the crane, a maximum of 667 individuals in autumn, in RAV, and the risk is the highest for the clearances between 35 and 50 m. In the case of cumulative impacts, it should be noted that due to the flight trajectory (from north-east to south-west and vice versa) it is very unlikely that migratory birds will encounter more than 2 OWFs on their way due to their linear arrangement along the west-east axis. It is, therefore, important, to emphasise that the cumulative impacts represent a deliberately overstated mortality should the birds actually encounter all the OWFs along their route. Hence, the significance of the cumulative impact was still assessed as moderate in the case of cranes and common scoters. The good condition of these species' populations, even at the maximum collision mortality rates, will not change. The negligible significance of the cumulative risk of collision was established for the long-tailed duck, common scoter, velvet scoter and geese.

The detailed results of the calculations for both the single Baltic Power OWF and for the case including the cumulative impacts of the Baltic Power OWF and other existing, implemented and planned projects are presented in Appendix 4 to the EIA Report.

5 Description of the environmental impact anticipated if the project is not implemented, taking into account the available information on the environment and scientific knowledge

Failure to implement the project consisting in the construction and exploitation of the Baltic Power OWF may take place in two cases, i.e.:

- complete abandonment of offshore wind energy in the PMA, which in consequence means the necessity to generate energy from the existing or other sources;
- abandonment of the Baltic Power OWF project with a power output of 1200 MW with the simultaneous implementation of other OWFs within the Polish EEZ.

The aforementioned options are fundamentally different. The first one would mean in the long term the abandonment of the use of an alternative source of electricity with a significant power output (e.g. the Baltic Power OWF itself would cover approx. 3% of national electric power demand), which would require a compensation through exploitation of conventional sources with a similar power output, along with the emissions of gaseous and particulate pollutants from combustion of fuels (hard coal or lignite), the generation of approx. 20% of waste from combustion in relation to the amount of the fuel combusted, and indirectly with the effects of environmental changes in the areas where fossil fuels are extracted.

An important premise for the implementation of the project is the potential avoidance of emissions of hazardous substances to the atmosphere. Assuming the use of 45% of its power output and 25 years of exploitation, a 1200 MW OWF can generate 134.03 TWh/482.51 PJ of electricity, thus, avoiding the emission of over 48 million Mg CO_2, over 650 thousand Mg SO_2, about 88 thousand Mg of nitrogen oxides and more than 1.5 million Mg of dust in lignite-fired power plants [126].

The above option will have local benefits related to abandoning the development of offshore areas. Failure to invest in offshore wind energy (wind turbines, power cables, substations) will in practice mean that complex impacts related to the construction, exploitation and decommissioning of these elements of the OWF will not occur over a period of several dozen years. This also entails the absence of restrictions on the availability of these areas to the existing and potentially new users [navigation, fisheries, tourism and possible production of hydrocarbons (crude oil and natural gas extracted below the seabed)].

The second option will mean the implementation of other wind farms in other sea areas, with a set of impacts on the marine environment and on human activities occurring there (navigation, production of hydrocarbons, fisheries, maritime tourism) that is difficult to estimate. However, this option has the advantage of reducing the effects of domestic fossil fuel extraction and combustion in conventional power plants. At the same time, while limiting the share of conventional energy in electricity generation, it will be possible, in accordance with the trends in the European power sector, to deepen the integration of the Polish extra high voltage transmission systems with Germany, Denmark and Sweden.

For each of the two situations indicated above, the expected impacts on abiotic and biotic elements of a varied degree and extent will not occur. These elements will be subject to the existing impacts resulting from the existing pressures in the marine environment.

6 Identification and assessment of the project impacts

This impact analysis was carried out separately for the construction phase, the overlapping construction and exploitation phases (from 2 to 8 years), as well as exploitation and decommissioning phases of the OWF.

6.1 Applicant Proposed Variant (APV)

6.1.1 Construction phase

6.1.1.1 Impact on geological structure, seabed sediments, access to raw materials and deposits

An important part of the assessment of the project impact on the processes taking place on the seabed and the seabed itself is to determine the scale of impact intensity and impact range. The impact is considered significant if the change to the nature of the surface and the structure of the seabed is greater than the size of geomorphological forms potentially occurring at the seabed. The impact range determined as local, in geological and geomorphological terms, refers to spot changes (foundation works) or linear changes (laying of cables) to the topography and structure of the seabed and is no larger than the dimensions of forms possibly created in a given area.

The sensitivity, i.e. the response of the seabed topography and structure, is assessed on a five-step scale in accordance with the data from the table (Table 6.1).

Table 6.1. Sensitivity of seabed topography to impacts resulting from activities related to the OWF construction

Sensitivity	Description
Negligible	No changes to the topography and structure of the seabed or changes similar to the ones observed caused by natural processes
Low	Changes noticeable, but not altering the character of the topography and structure of the seabed; local range
Moderate	Changes noticeable, altering the character of the topography and structure of the seabed to a degree not affecting the general character of the area; local range
High	Changes affecting the topography and structure of the seabed, altering its character and affecting processes taking place on the seabed; local range, limited to the project area, possible small impact on the character of the topography of adjacent areas
Very high	Changes significantly affecting the topography and structure of the seabed in the area analysed, which may significantly affect geological and geomorphological processes of the project area and adjacent areas

6.1.1.1.1 Impact on geological structure

Depending on its structure, the seabed may exhibit different sensitivity to the impact of the project during the construction phase. The seabed made of till and till with a stony cover is difficult to wash out and withstands morphological changes. A sandy, sandy and silty, and silty seabed is more susceptible to washout and material being moved over it, e.g. in the form of sandy waves. Thus, the elements of the OWF infrastructure may be uncovered or buried, both as a result of natural processes involving the movement of rock material along the seabed and as a result of this movement being disrupted by the OWF infrastructure components.

Activities connected with the project construction may cause the following types of impact on the seabed:

- local spot changes in the seabed structure when it is necessary to replace/reinforce the ground where wind power stations are to be located (some types of foundations or support structures require laying protective layers around their bases to prevent washout; for this purpose, crushed stone, stones and boulders are most often used; these actions cause a change in the subtractive composition of seabed sediments);

- a spot disturbance of the geological structure due to embedding elements of foundations or support structures of the power station (drilling or pile-driving of foundations or support structures, erection of support structures, laying or possible burying of cables, dredging works);
- changes in the shape of the seabed due to: preparing the seabed for the foundation or support structure, laying of cables, levelling of seabed unevenness along the cable route; changes in the seabed morphology will also occur as a result of the possible storage of rock material excavated to prepare the seabed for foundations or support structures;
- seabed level changes due to the deposition of rock material raised and moved during preparatory and construction works (from suspended solids);
- pits forming in the seabed at the anchoring locations of vessels installing elements of the OWF infrastructure;
- the disturbance and sedimentation of suspended solids − during construction works, suspended solids will be disturbed locally, which will cause the water to become turbid. Suspended solids generated as a result of sediment disturbance during dredging works deposits at the seabed depending on the water movement in the area. The disturbed sediment will move mainly within the OWF Area and no further than a dozen kilometres from its boundaries (in trace amounts), and during the deposition, it will cover the seabed with an average thickness of no more than 0.2 mm, which is comparable to the amount of suspended solids deposited as part of natural processes during the year.

The overall impact of the project during its construction phase was assessed as negligible for the general nature of the seabed and its structure – the changes will be minor, over a small surface of the seabed, local (foundations or support structures of wind power stations) or linear (along the cable route).

6.1.1.1.2 Impact on seabed sediments

In geological terms, taking into account the nature of deposits forming the seabed surface of the OWF Area, no significant changes in the nature of deposits are expected. Possible changes may occur only locally, where it is necessary to replace weak soil with soil of appropriate parameters, but this will mainly depend on the technology selected. Considering the following types of foundations: large-diameter monopiles, jacket foundations, tripod structures, GBS, and floating foundations, changes in the sediment nature should be expected in the case of soil replacement for large-diameter monopiles, jacket foundations, tripod structures and GBS. In the vicinity of individual wind power stations, the character of surface sediments will change and, locally, where foundations or support structures are inserted into the seabed (large-diameter monopiles, tripod structures, jacket foundations) – sediments forming the seabed will change.

The total area of the OWF determined in the PSzW No. MFW/6/12, as amended, is 131.08 km^2, of which the Development Area shall not exceed 113.72 km^2. Changes in the nature of surface sediments will concern the seabed on which the foundation of 126 wind power stations (0.29925 km^2) will be built, which constitutes only 0.26% of the Development Area. The impact on surface sediments will be negligible.

6.1.1.2 Impact on seawater and seabed sediments quality

Water and seabed sediments constitute very important elements of the water ecosystem of the Baltic Sea, which is shallow and small with limited water exchange through the narrow and shallow Danish Straits. The surface of the sea is approximately 4 times smaller than that of its catchment area. Approximately 85 million people live in this area. These conditions make any interference in the marine environment such as fishing, shipping, household and industrial sewage discharge, surface runoff from industrialised and agricultural areas, but also activities related to seabed exploration and development, affect the delicate ecological balance of the sea [424]. Water and sediments in bodies of water are strictly connected with each other. A form of balance exists between the various components of the marine environment and, in particular, between water and seabed sediment. A change in one component (e.g. sediments) causes changes in the other (water) and vice versa.

Most pollutants (heavy metals and toxic organic compounds of low solubility and slow degradation) which are released into the environment as a result of human economic activity and reach surface waters are retained in sediments [49]. However, sediments are not only a place where persistent and toxic pollutants released into the environment are deposited, but also where many aquatic organisms live, feed, multiply and grow. Contaminated sediments pose high risks to the biosphere, because some of the harmful substances contained in sediments may pass into the water as a result of chemical and biochemical processes and be accessible to living organisms [140, 56].

This subsection identifies, characterises and evaluates the impact of the OWF on the quality of sea water and seabed sediments. It was found that, during its construction phase, the OWF may cause various types of impacts on the recipients discussed (water and seabed sediment); these include: the release of pollutants and nutrients from sediments to water, contamination of water and seabed sediments with oil derivatives, contamination of water and seabed sediments with anti-fouling agents, contamination of water and seabed sediments with accidentally released municipal waste or domestic sewage, contamination of water and seabed sediments with accidentally released chemicals and waste from the construction of the Baltic Power OWF.

Release of pollutants and nutrients from sediments into water

The disturbance of the seabed sediments connected with the construction (laying) of foundations or support structures for the OWF facilities, anchoring of vessels or burying of a cable is a process which contributes to pollutants passing from sediments into water [424, 49, 140, 56, 100]. During construction works, substances including labile metal forms, persistent organic pollutants (POPs), i.e. polycyclic aromatic hydrocarbons (PAHs) and PCBs, nutrients (nitrogen and phosphorus compounds) will pass into the water.

The most important parameters influencing the impact level are: the dimensions and number of foundations or support structures, the length of cable sections and the width and depth of the cable trench, the types and amount of pollutants accumulated in seabed sediments and the type of rock material forming the seabed.

The passage of pollutants from sediments into water (and thus a change in water quality) and the formation of long-lasting suspended solids depend on the type of sediment. The largest amount of pollutants and nutrients will be transferred to water from the sediments with an increased organic matter content (e.g. silty, clayey sediments with a higher concentration of metals and POPs). These deposits will also contribute to the formation of more suspended solids, which will remain in the water for a long time. Intense resuspension may cause the release of nutrients immobilised in the sediment and contribute to eutrophication. In case of sandy deposits with low organic matter content (e.g.

coarse sandy sediments), the described processes will be less intense. These sediments are generally characterised by a small amount of fine-grained fractions and a low concentration of metals and persistent organic pollutants. Therefore, it is estimated that the processes related to the release of nutrients and POPs will occur at low intensity in the entire Baltic Power OWF Area.

It should be emphasized that substances released from the sediment will pass into water. However, within approx. 1 year from the end of the construction activities, these substances will transfer back into sediments after reaching an equilibrium.

The most far-reaching scenario is the use of the GBS both in the APV and in the RAV. Their construction requires the preparation of the seabed, which may involve the removal of a layer of seabed sediments, not only where the foundation or support structure is placed but also in its direct vicinity.

In the case of other technologies analysed (large-diameter monopile, tripod structure, jacket structure), the volume of sediment disturbed will be many times smaller, because in most cases these structures do not require seabed preparation and also the diameter of the foundation piles driven will be many times smaller than the GBS diameter. The sediment around the driven piles will liquefy as a result of vibrations caused by the operation of the pile driver.

An example calculation of the amount of sediment disturbed for a monopile with a diameter of 12.50 m is presented below. Assuming that piles of such diameter will be driven several dozen metres into the seabed, it can be assumed that sediments deposited at the depth of approx. 1 m will be disturbed within a radius of approx. 3 m from the pile. The volume of sediment disturbed during pile driving into the seabed was calculated using the following formula:

$$V_{a} = V_{tr\ cone} - V_{cyll.},$$

where:

V_{a} – volume of the sediment layer disturbed during pile driving into the seabed,

$V_{tr\ cone}$ – volume of the truncated cone with a height of 1 m and a base diameter of 18.5 m,

$V_{cyll.}$ – volume of a cylinder – the part of the embedded foundation: 1 m in height and 12.5 m in diameter.

Once the values are substituted in the formula, the volume of sediment disturbed during the driving of one pile into the seabed amounts to approx. 70 m^3 of sediment per foundation or support structure.

Additionally, regardless of the type of foundation or support structure selected, sediments will be disturbed during cable laying. The width of the cable trench is approx. 1.5 m, its average depth – up to 3 m and its length – up to 600 km, which gives a total of 2 700 000 m^3 of disturbed sediment (for the entire internal cable network).

Moreover, during the construction of foundations or supporting structures and the installation of towers, seabed sediment disturbance due to anchoring of vessels will be observed. The anchoring process itself is short-term, affecting a small area (local) to a depth of approx. 3 m, so the volume of the sediment disturbed will be small.

Based on the above assumptions and concentrations of pollutants and nutrients found in the OWF Area (subsection 3.2.2), an estimation of their release into water in the APV and RAV was made.

The calculations assume an average sediment volumetric density of 1.52 g cm^{-3} (1520 kg m^{-3}) and average sediment moisture content of 17.7%. For the purpose of calculations, the volume of sediments necessary to be removed for the correct installation of the foundation or support structure was assumed as 9800 m^3 (APV) and 4700 m^3 (RAV).

The estimated amount of heavy metals, pollutants and nutrients that may be released in the APV and RAV during their implementation as part of the Baltic Power OWF project is presented in the table below (Table 6.2). They will not be significant compared to the loads entering the Baltic Sea each year through rivers and rain [424], which are also presented in the table below.

Table 6.2. Comparison of the mass of pollutants and nutrients that may be released into water during the construction of the Baltic Power OWF (construction phase, APV, RAV) with the load entering the Baltic Sea through rivers and rain [Source: Baltic Power Sp. z o.o. data]

Parameter	**One gravity based structure (GBS)**	**APV (126 foundations)**	**RAV (240 foundations)**	**1 km of cable**	**Cable routes (600 km)**	**Annual load entering the Baltic Sea through rivers**	**Annual load entering the Baltic Sea through rain**
Volume of the sediment disturbed	9800 m³ (APV) 4700 m³ (RAV)	1 234 800 m³	1 128 000 m³	4500 m³	2 700 000 m³	No data available	No data available
Weight of the sediment disturbed	14 896 Mg (APV) 7144 Mg (RAV)	1 876 896 Mg	1 714 560 Mg	6840 Mg	4 104 000 Mg	No data available	No data available
Dry weight of the sediment disturbed	12 259 Mg (APV) 5880 Mg (RAV)	1 544 685 Mg	1 411 083 Mg	5629 Mg	3 377 592 Mg	No data available	No data available
Lead (Pb)	30.3 kg (APV) 14.5 kg (RAV)	3818 kg	3480 kg	13.9 kg	8340 kg	50 000 kg	200 000 kg
Copper (Cu)	9.6 kg (APV) 4.6 kg (RAV)	1210 kg	1104 kg	4.4 kg	2642 kg	100 000 kg	No data available
Chromium (Cr)	11.9 kg (APV) 5.7 kg (RAV)	1499 kg	1368 kg	5.4 kg	3240 kg	No data available	No data available
Zinc (Zn)	67.7 kg (APV) 32.4 kg (RAV)	8530 kg	7776 kg	31.0 kg	18 610 kg	No data available	No data available
Nickel (Ni)	9.1 kg (APV) 4.4 kg (RAV)	1147 kg	1056 kg	4.2 kg	2520 kg	700 000 kg	No data available
Cadmium (Cd)	Concentration in the Baltic Power OWF sediments below the limit of quantification					7 Mg	7 Mg
Mercury (Hg)	Concentration in the Baltic Power OWF sediments below the limit of quantification					2 Mg	3 Mg
PCB congeners	< 0.006 g (APV) < 0.003 g (RAV)	<0.756 g	<0.720 g	<0.003 g	<1.72 g	715 000 g	260 000 g
PAH analytes	< 0.000 612 to 0.1692 kg (APV) < 0.000 294 to 0.08114 kg (APV)	< 77.11 to 21.3 kg	< 70.56 to 19.5 kg	< 0.281 to 77.68 g	< 169 to 46.61 kg	No data available	No data available

Parameter	One gravity based structure (GBS)	APV (126 foundations)	RAV (240 foundations)	1 km of cable	Cable routes (600 km)	Annual load entering the Baltic Sea through rivers	Annual load entering the Baltic Sea through rain
Available phosphorus (P)	823 kg (APV) 395 kg (RAV)	103 698 kg	94 800 kg	378.14 kg	226 884 kg	12 000 000 kg (total P)	No data available
Nitrogen (N) * (sandy sediments)	245.1 kg (APV) 117.6 kg (RAV)	30 895 kg	28 224 kg	112.58 kg	67 548 kg	190 000 000 kg (total N)	No data available
Nitrogen (N)* (till sediments)	5639.1 kg (APV) 2704.8 kg (RAV)	710 526 kg	649 152 kg	2589.34 kg	1 553 604 kg	190 000 000 kg (total N)	No data available

**In order to estimate the amount of total nitrogen released from sandy sediments, a content of 200 mg kg^{-1} of this element was assumed, whereas 4600 mg kg^{-1} of total nitrogen was assumed for till sediments*

It was assumed that all sediments removed from the construction sites of foundations or support structures during seabed preparation will be left in the Baltic Power OWF Area. If a different decision is made and the sediment removed is transported to shore, the level of heavy metals, pollutants and nutrients released will be lower. Similarly, if other types of foundations or support structures (large-diameter monopile, jacket structure, tripod structure) are used, for which the seabed area disturbed including the sediments on it is significantly smaller, the impact will be smaller.

At the same time, disturbing seabed sediments may slightly improve their quality (increase in oxygenation and decrease in the amount of pollutants and nitrogen compounds in the sediment due to their transfer to water). Better oxygenation of sediments may reduce phosphorus transfer from sediments as this process takes place in anaerobic (reducing) conditions [8].

The sensitivity of sea waters was assessed as moderate.

The release of pollutants and nutrients from seabed sediments during the construction phase is a direct negative impact of a regional range, short-term, reversible or irreversible, repeating during the construction period, characterised by low intensity.

The significance of this impact during the construction phase in the APV was classified as insignificant for sea waters and as negligible for seabed sediments.

Contamination of water and seabed sediments with oil derivatives during normal operation of vessels during construction and during their breakdown or collision

Pollutants entering water during normal operation of vessels form the second largest source of oil pollution at sea. This is the source of approx. 33% of oil released into the environment (mainly due to increased maritime traffic in the Baltic Sea region) [211]. In comparison, approx. 37% of oil entering the sea is a run-off from land brought by rivers, while the tanker disasters only rank third (12%).

During the construction phase, vessels (ships, barges, etc.) will be used, from which small leaks of oil derivatives (lubricating oil, fuel oil, petrol, etc.) may occur during normal operation. To a minor extent, they may contribute to the deterioration of water quality.

It should be assumed that these will be small spills (I degree), up to 20 m^3. Visible traces of such contaminants may disappear spontaneously in favourable conditions, as a result of evaporation and dissipation in water. In practice, the size of these spills will be limited to the Baltic Power OWF Area.

The sensitivity of sea waters and seabed sediments to small spills of oil derivatives occurring during the normal operation of vessels was assessed as insignificant.

Contamination of sea waters or seabed sediments with oil derivatives released during normal operation of vessels form a direct negative impact of local range, momentary or short-term, reversible, repeatable, characterised by low intensity.

The significance of this impact during the construction phase in the APV was assessed as negligible for sea waters and seabed sediments.

The leakage of oil derivatives resulting in the contamination of water and seabed sediments may also occur in emergencies (as a result of a breakdown or a collision of vessels, a construction disaster of one of the Baltic Power OWF facilities, as well as during maintenance works). Such events may contribute to the deterioration of coastal water quality (if the spill reaches the shore). In the event of a collision of vessels, a III degree spill can be expected, i.e. one above 50 m^3 and up to approx. 200 m^3.

A visible effect of an oil spill is an oil slick which, under the influence of gravity and surface tension, spreads at a speed depending on the type of oil and ambient conditions. The size of the spill is determined by such factors as oil volume, density, viscosity, temperature, wind speed and time. The estimated speed of an oil slick movement in large water bodies is approx. 2–3% of the wind speed. It was found that a spill of 1.6 t (1.8 m^3) of oil spreading over the surface of 1 km^2 during one day forms a dark film with a thickness of 2 µm. 40 kg of oil, on the other hand, causes a slick on the surface of 1 km^2 that has a film thickness of 0.05 µm [166].

Oil film formed on the water surface may cause:

- impeded exchange of gases, especially of oxygen, between water and the atmosphere;
- 5–10% decrease in light intensity under the water surface (mainly due to the presence of heavy fractions of oil and sulphur) limiting photosynthesis;
- increase in the temperature of water during the day as a result of light absorption by the oil layer.

While an oil slick is spreading, other degradation processes are progressing which lower the concentration of hydrocarbons on the water surface (e.g. the release of low molecular weight hydrocarbons). Heavier oil fractions may undergo sorption on the surface of organic and mineral suspensions, which may increase their specific gravity and gradually make them sink to the seabed. Thus, heavier oil fractions may be bound by seabed sediments, contaminating them. The susceptibility of seabed sediments to contamination depends on the grain size of the sediment and its packing. Loose sandy sediments are more susceptible to contaminant absorption. Compact till sediments inhibit the penetration of contaminants into the sediment. However, due to the type of sediments in the Baltic Power OWF Area (small amount of organic matter and low content of fine fractions), oil spills will not cause a noticeable deterioration of their quality.

The probability of a breakdown or a collision of vessels in the Baltic Sea is low. Approx. 2 thousand vessels sail the Baltic Sea every day (including 200 tankers transporting oil and other liquids), and the number of collisions and failures in recent years has remained more or less constant (with a slight increase), i.e. approx. 120−190 accidents at sea every year. The majority of accidents in the Baltic Sea cause no contamination. The number of accidents with contaminant release into water is up to 21 (which occurred in 2017) per year. However, it must be kept in mind that even one large-scale accident may seriously threaten the marine environment. In 2017, 139 vessel accidents occurred in the Baltic Sea area, 21 of which resulted in contamination. None of the accidents that resulted in water contamination and required a clean-up occurred in the Polish Exclusive Economic Zone [179]. 2017 saw 8 confirmed oil spills less than 1 m^3 in volume, one with a volume in the range of 1–10 m^3 and one larger accident with a volume of 200 m^3 [179].

In the south-eastern Baltic Sea area, where the Baltic Power OWF Area analysed is located, the risk of a collision with a spill of over 5000 tons was estimated to be 1 in 1060 years, whereas the areas under the greatest threat are found around the Wolin and Rüggen islands and the Hel Peninsula (www.brisk.helcom.fi).

During construction works, vessels sail at low speeds, and therefore the risk of damage to the fuel tank is very low. A vessel generally holds fuel in several tanks, which reduces the risk of a major leak in case of a collision. Vessels used in the construction of wind farms may have fuel tanks with the total capacity of approx. 1200 m^3. Assuming a breakdown or a collision of the largest vessels used at the construction phase of the Baltic Power OWF (during inspections, maintenance and emergency repairs) and the destruction of the largest tanks of one vessel, no more than 200 m^3 of fuel oil, 15 m^3 of machine oil and approx. 2.5 m^3 of hydraulic oil may be released from one vessel (in the worst-case scenario) [434].

In the event of a construction disaster at the OWF (a wind power station falling over or a vessel colliding with the wind power station or a substation), a leak of fuel oil (up to 100 m^3), machine oil (up to 15 m^3), hydraulic oil (up to 2.5 m^3) or transformer oil (up to 80 m^3) may occur.

The most important parameters affecting the level of impact are: type and amount of oil derivatives released, weather conditions and the type of rock material forming the seabed.

The sensitivity of both receptors may be high in case of emergency or collision situations.

Moreover, a plan will be prepared for the Baltic Power OWF to prevent risks and contamination during the construction, exploitation and decommissioning of the OWF. This plan should specify the potential area under threat for various breakdown and disaster scenarios, as well as the methods of preventing and eliminating oil spills.

Contamination of water or seabed sediments with oil derivatives released in an accident is a direct negative impact of regional range, being short-term, reversible, repeatable and of high intensity.

The significance of this impact during the construction phase in the APV, due to the random and sporadic nature of breakdowns and collisions was assessed as low for sea waters and seabed sediments.

Accidental contamination of water and seabed sediments with anti-fouling agents containing organotin compounds (e.g. TBT)

Hulls of vessels are protected against fouling with biocides, which may contain e.g. copper, mercury and organotin compounds (e.g. TBT). These substances may pass into the water and eventually be contained in the sediment. It should be assumed that the releases of those compounds will be limited due to their dilution in the water. Of the substances listed, organotin compounds are the most harmful (toxic) to aquatic organisms. The use of TBT (the most harmful substance) in anti-fouling paints is now prohibited, but the presence of those compounds in older vessels cannot be ruled out. The sensitivity of sea waters and seabed sediments to biocides released from hulls was assessed as medium.

Vessels (ships, barges, etc.) will be used at each phase of the project and their hulls may release certain amounts of anti-fouling substances into the water during normal operation. Consequently, they can contaminate sediments. To avoid this, at every stage of the project it is recommended to use vessels the hulls of which have not been coated with anti-fouling paint containing TBT. This will eliminate this most harmful impact on aquatic organisms.

The most important parameters influencing the level of impact are the type and amount of anti-fouling substances released as well as the type of rock material forming the seabed.

The sensitivity of both receptors is moderate.

Contamination of water or seabed sediments with antifouling substances during the construction phase forms a direct, negative impact of a local or regional range, short-term, reversible, repeatable during the construction period, of low intensity.

The significance of this impact during the construction phase in the APV was assessed as negligible for sea waters and seabed sediments.

Contamination of water and seabed sediments by accidental release of municipal waste or domestic sewage

At each project stage, waste − mainly municipal and other, not related to the construction process directly, as well as domestic sewage will be generated on vessels and at the onshore site facilities (located in the port supporting the project implementation). Waste and sewage may be accidentally released into the sea while being received from vessels by another vessel and during a breakdown, resulting in a local increase in nutrient concentrations and the deterioration of water and sediment quality. However, the pollutants are expected to disperse quickly, and thus will not contribute to a permanent deterioration of the environment in the project area. The sensitivity of sea waters and seabed sediments to this type of impact is assessed as low.

The most important parameters affecting the level of this impact are the type and quantity of released waste or sewage, weather conditions as well as the type of rock material forming the seabed.

The sensitivity of both receptors is negligible.

Contamination of water or seabed sediments with municipal waste or domestic sewage is a direct negative impact of a local range, short-term or momentary, reversible, repeatable during the construction period, of low intensity.

The significance of this impact during the construction phase in the APV was assessed as negligible for sea waters and seabed sediments.

Contamination of water and seabed sediments by accidentally released chemicals and waste from the construction of the OWF

During the construction of the offshore wind farm, waste directly related to the construction process will be generated on vessels, at onshore site facilities (located in the port handling the implementation of the project) and on the project site. These may include, among others, damaged parts of the OWF components, cement, joint grouts, mortars, machine fluids and other chemical substances used or replaced during construction works. They may be accidentally released into the sea.

This waste is mainly generated during the construction and decommissioning phases [most often waste from group 17 of the Annex to the Regulation of the Minister of Climate of 2 January 2020 on the waste catalogue (Journal of Laws of 2020, item 10)]. Waste produced during the construction phase will include e.g. cable scrap, sanitary waste from ships, flammable waste, oil and chemical waste, as well as construction waste. Waste should be neutralised in accordance with the applicable regulations concerning industrial waste.

The most important parameters affecting the level of this impact are the type and quantity of waste or sewage released, weather conditions and the type of rock material forming the seabed.

Bulk cement is packed in bags of approx. 1 m^3 each. It was assumed that during reloading activities, approx. 5 m^3 of this product may sink. Grouts, mortars and other binders often contain hazardous substances. For example, epoxy (two-component) binders contain various proportions of: epoxy resin, alkyl-glycidyl ethers and polyaminoamides. When released into water, these substances, due to their high density (approximately 1.3 g cm^{-1}) sink and deposit on the seabed. They are considered a serious threat because they cannot be easily removed from the seabed and are toxic to marine organisms.

Generally, for projects such as the Baltic Power OWF, a detailed plan is prepared to prevent the risks and contamination generated during the construction, exploitation and decommissioning of the OWF, which contains mitigating measures and a procedure to be followed in case of such events.

The sensitivity of both receptors to this impact is moderate.

Contamination of water or seabed sediments connected with the OWF construction process is a direct, negative impact of a local range, short-term or momentary, irreversible, repeatable during the construction period, of medium intensity.

The significance of this impact in the construction phase in APV was assessed as negligible for sea waters and as low for seabed sediments.

6.1.1.3 Impact on climate, including greenhouse gas emissions and impacts relevant in terms of climate change adaptation and impact on the air (state of the air)

As part of identifying the project impact on meteorological conditions, one-year-long measurements of meteorological parameters including wind, the pressure, humidity and temperature of air were analysed and the available literature concerning air quality and climatic conditions for the Baltic Sea was reviewed.

During the construction phase of the Baltic Power OWF, an increased emission of pollutants into the atmosphere (including greenhouse gases) can be expected, due to the increased traffic of vessels involved in project construction. The magnitude of these atmospheric emissions cannot be assessed at this stage, as the number, type and duration of use of specialist vessels will only be determined in the detailed design. It was assumed that only vessels which comply with national standards and those resulting from international agreements on pollution emissions would be used.

According to the findings of the GP WIND project [161], energy production in OWPS involves emitting from 6 to 34 kg of CO_2 per 1 MWh in all OWF lifecycle phases, which results in between 0.8 and 4.6 million Mg CO_2, given the expected yield of 134.03 TWh during 25 years of exploitation. The higher of the values quoted refers to the case in which a gravity-based structure with a high proportion of cement is used. Even in this case, the emissions will be at least 10 times lower in comparison with the energy production from other sources fired with hard or brown coal (emission reductions of over 48 million Mg of CO_2 are expected – without taking into account the emissions related to the construction of these sources).

During the construction phase, the significance of the planned project impact on climate and greenhouse gases will be negligible, as there will be no factors that could have a noticeable impact on their change.

The impact on air quality during the construction phase of the planned project will be temporary and will disappear after the works are completed. Furthermore, since the area is open and unobstructed, pollutant concentrations will decrease rapidly. Therefore, the significance of the impact will be negligible.

6.1.1.4 Impact on nature and protected areas

6.1.1.4.1 Impact on biotic elements in the marine area

6.1.1.4.1.1 Phytobenthos

No impacts due to the absence of any phytobenthos in the OWF Area before the beginning of the project implementation.

6.1.1.4.1.2 Macrozoobenthos

During the construction phase of the Baltic Power OWF, works carried out on the seabed will cause the following impacts, affecting the condition of macrozoobenthos inhabiting the area:

- disturbance of the seabed sediment structure;
- increased concentration of suspended solids in water;
- sedimentation of suspended solids at the seabed;
- redistribution of pollutants from sediments into water.

The assessment of the impact of wind power stations in the OWF Area (1 NM) during the construction phase was carried out separately for:

- soft bottom macrozoobenthos;
- hard bottom macrozoobenthos.

These two sets of benthic fauna differ in taxonomic composition, abundance and biomass of their constituent species. Therefore, they differ in sensitivity and importance of the evaluated group of organisms. The sensitivity of macrozoobenthos depends on the type of impact and preferences resulting from the very biology of the species concerned. On the one hand, it is the ability of the population to adapt to various changes occurring in the environment as a result of the project implementation and, on the other hand, the ability of a complex of organisms to reconstruct the quantitative structure after the impact factor ceases to exist.

The complex of soft bottom macrozoobenthos occupies the sandy seabed with the largest surface area in the area of the planned project and is characterised by moderate ecological quality. This complex is of low importance, comprising species that are common and typical of the soft bottom of the Southern Baltic, and their biomass is dominated by organisms tolerant to environmental degradation.

The complex of hard bottom macrozoobenthos inhabiting the surface of boulders and stones, found in the southern and north-eastern part of the planned OWF (1 NM), occupies up to 5% of its surface area. The valorisation of the hard bottom demonstrated a higher degree of natural value of this type of habitat, which had a good ecological status. The significance of this group of benthic fauna is moderate because, despite the small area it occupies, it consists of habitat-forming bivalves, including bay mussel *Mytilus* sp., which play an important role in the food chain. The local range of this complex results from the fact that it is limited to a specific area of the boulder area occupied.

The first of the impacts described, negatively affecting macrozoobenthos and causing the physical destruction of natural communities, is **the disturbance of the seabed sediment structure**. Excavating material for foundations or support structures and the anti-erosion layer, levelling the seabed, burying power and communication cables in the seabed, dumping excavated material in the storage area, as well as the operation of jack-up type construction vessels are factors with the greatest impact on macrozoobenthos species inhabiting the surface of sandy, gravelly and silty sediments as well as the stony seabed which cannot move inside the sediment [224, 471, 36]. Increased macrozoobenthos mortality will also occur when invertebrates are brought to the sediment surface, resulting in their physical elimination or predation pressure. Only mobile macrozoobenthos species, i.e. crustaceans of the *Malacostraca* class, occurring in both the soft and hard bottom macrozoobenthos complexes, will avoid adverse environmental conditions by escaping.

The disturbance of the seabed sediment structure is the most negative type of impact of all those occurring during the construction phase. The sensitivity of soft bottom macrozoobenthos to this impact is low. This means that the complex will be able to recover and return it to its original condition after the impact factor ceases, within one year, but only in places where there is no permanent mechanical destruction of benthos under the surface of foundations or support structures of wind power stations. On the other hand, the sensitivity of bivalves, which are a group of absolutely constant taxa within the hard bottom complex, is moderate, which means that some of the species in the benthos complex will be destroyed and the survival of the remaining ones may be limited. Once the impacting factor disappears, the longest living species in this group, bivalves, may need several years before they are able to restore their quantitative structure.

In the APV, we assume that all types of foundation of wind power stations are permitted (e.g. large-diameter monopiles, jacket foundations, tripod structures, GBS, floating support structures). However, GBS foundations represent the worst case scenario in terms of the negative impact on macrozoobenthos because they occupy the largest seabed area. The total area of the OWF, determined in the PSzW No. MFW/6/12, as amended, is 131.08 km^2, of which the Development Area will not exceed 113.72 km^2. Macrozoobenthos will be physically destroyed on the seabed area disturbed by the installation of 126 wind power station foundations (0.29925 km^2) and along the route of internal power cables (1.8 km^2, assuming the width of the cable ditch as 3 m), i.e. on the total area of 2.1 km^2, which constitutes only 1.85% of the Development Area.

The Baltic Power OWF Area is not unique in terms of the qualitative and quantitative composition of macrozoobenthos, compared to similar benthic habitats in the remaining part of the Polish Maritime Area within the same depth range in open waters of the Southern Baltic. The scale of the impact described is small for the soft bottom macrozoobenthos and moderate for the hard bottom macrozoobenthos, so in the case of the soft bottom macrozoobenthos, which is highly able to recover its resources in a relatively short time, this impact should be considered negligible, whereas in the case of the hard bottom macrozoobenthos, with bivalves being able to re-colonise underwater parts of wind power stations, this impact will be of low significance.

Another type of impact on the macrozoobenthos of the Baltic Power OWF Area consists in **an increased content of suspended solids in water**. As a result of the structure of seabed sediments being disturbed by dredging works as well as during the laying and burying of power and communication cables in the seabed, suspended solids rise from the seabed and disperse in the water [249, 471]. When there is an excessive concentration of suspended solids in the water, organisms that filter-feed or feed on suspended solids and organic matter deposited in sediments feed less effectively. When the concentration of suspended solids exceeds 250 mg·l^{-1}, the growth of macrozoobenthic organisms is restricted [121]. In addition, increased mortality of bivalves is noted due to the clogging of their filtering system [292]. What is more, bivalves from the Baltic Sea are physiologically less suited to filtering suspended solids at high concentrations because they are not adapted to life in conditions of strong currents or tides [121, 81].

Model analyses of suspended solids dispersion in the Baltic Power OWF Area show that the GBS system would be the least favourable for the macrozoobenthos in terms of the impact of suspended solids released into the marine environment, both in APV and RAV. The ranges of suspended solids dispersal will be the greatest when moderate winds blow in constant directions, and the highest concentrations of suspended solids will be observed when sea currents are slow (several cm·s^{-1}) and if the currents are circulating. Higher concentrations of suspended solids, caused by dredging works, ranging from several to several dozen mg l^{-1} depending on the depth of the sea area, the diameter of the foundation or support structure of the wind power station and the type of sediment, occur locally around the place of works not exceeding 1200 m, and, in the least favourable scenario, their impact on the marine environment will not last longer than 64 hours from the beginning of works in the seabed on a single foundation. In the Baltic Power OWF Area, where depths range from 28.1 to 45.4 m, there are slightly more sandy sediments and cohesive soils with a significant share of silt and clay fractions which during dredging works cause greater suspended solids interference into the marine environment as they get suspended in the water. During power and communication cable laying, the maximum suspended solids content will reach lower values than during the construction works on the foundations of OWF support structures. Detailed results of the modelling calculations of suspended solids dispersion in the

Baltic Power OWF Area are included in Appendix 2 to the EIA Report. Taking into account the above results and the negligible sensitivity of the soft bottom macrozoobenthos complex (the stressor has a very small impact on the changes to the structure and functioning of this complex) as well as the low sensitivity of the hard bottom macrozoobenthos (the survival of some benthic species may be limited), mainly bivalves, to this type of effects, the impact of the increased suspended solids concentration on the macrozoobenthos in the OWF Area (1 NM) will be negligible for the soft bottom complex and of small significance for the hard bottom complex.

Sedimentation of suspended solids on the seabed is an impact causing the benthic habitat to be covered with an additional layer of sediment [471]. The macrozoobenthos is quite tolerant to being covered by an additional layer of suspended solids undergoing sedimentation, up to 0.2–0.3 m thick [121]. This is due to many macrozoobenthic organisms having to adapt to life under natural conditions of sediments lifting and falling on the seabed as a result of e.g. storms or the tidal cycle [183, 35]. The covering of the macrozoobenthos fraction living on the sediment surface (epifauna) will restrict its survival to a greater extent, because when these organisms are covered with an additional layer of sediment, they cannot move. However, the most important factor influencing survival in these conditions is access to oxygen dissolved in water, which can diffuse 1 to 2 mm deep into the sediment [183].

The maximum thickness of the newly formed sediments at the distance of 100 m from the place of preparatory works for a foundation or a support structure will not exceed 23.6 mm (cohesive substrate slightly prevailing in the OWF Area: till with sand, sand with till, sand with clay, sand with silts and compact till) and 4.6 mm in the case of non-cohesive sediments (fine, medium and coarse sands and gravel). However, 1000 m from the place of works, the thickness of new sediments in the maximum variant will be less than 5.4 mm. On the other hand, the thicknesses of sediment layers created anew as a result of laying power and communication cables will be much smaller, i.e. 8 mm at a distance of 100 m from the place of works performed in cohesive soils and 0.8 mm at a distance of 1000 m from the axis of the cable being laid. Although the final result, i.e. the sediments deposited on the seabed during the construction of foundations or support structures as well as cable burying is cumulative, according to the modelling calculations of the worst case scenario, the average thickness of sediments deposited on the entire area of the Baltic Power OWF as a result of construction works will not exceed 1.4 mm in the APV and 1.3 mm in the RAV. Thus, the sedimentation of the seabed sediments disturbed in the OWF Area and outside its boundaries will be of a local and short-term nature. Just as for the impact of the increased content of suspended solids in the water, the sensitivity of the macrozoobenthos complex to this type of impact is negligible for the soft bottom macrozoobenthos complex and low for the hard bottom macrozoobenthos complex. Because, on average, oxygen penetrates through a 1.35 mm thick sediment layer, even organisms that cannot generate energy in an anaerobic environment will be able to survive in such conditions, so the impact was assessed as negligible for the soft bottom macrozoobenthos complex and of low significance for the hard bottom macrozoobenthos complex. The results of hydrochemical measurements of the oxygen content made in the near-seabed layer of the Baltic Power OWF Area in the summer (July, August) of 2019 indicate good conditions (no oxygen deficit) [27].

As a result of the seabed sediment disturbance during installation works on the seabed, burying of power and communication cables or anchoring of vessels, **pollutants from sediments are redistributed into water.** This has a harmful impact on macrozoobenthos [56, 471, 424] by exposing benthic fauna to an increased concentration of pollutants contained in the sediments (e.g. heavy metals, toxic organic compounds) which escape into water as a result of chemical and biochemical processes. The accumulation of toxic substances, particularly by filter-feeding organisms, mainly in the soft tissues of bivalves, leads to diseases and increased mortality, thus decreasing the abundance and biodiversity of the seabed fauna [400, 143, 163].

The impact on the macrozoobenthos was indirectly determined using surveys of the physical and chemical condition of benthic sediments in the Baltic Power OWF Area with regard to their contamination. These surveys have shown that the benthic surface sediments from the OWF Area are inorganic and characterised by low concentrations of persistent organic pollutants (i.e. PAH, PCB, TBT, DBT, and MBT) and harmful substances such as heavy metals (arsenic, total chromium, zinc, copper, cadmium, lead, mercury, and nickel) or oil derivative hydrocarbons, and do not differ significantly from the data from literature on sandy seabed sediments of the Southern Baltic [171, 100, 229, 365, 401, 402, 424, 464, 382]. Moreover, the concentrations of labile forms of metals which determine, among others, their toxicity, bioavailability or accumulation in the seabed sediments of the OWF Area, were very low. The concentrations of the labile forms of the elements surveyed were distributed more or less evenly across the entire OWF Area [27]. The sensitivity of the soft bottom macrozoobenthos complex to the impact described is negligible, being low only for the hard bottom macrozoobenthos complex. Therefore, this impact on the soft bottom macrozoobenthos should be considered negligible, and on the hard bottom macrozoobenthos – of low significance.

The analysis of the pressure factors during the construction stage of the Baltic Power OWF has shown that the impacts are assessed as negligible or of low significance, whereas the most adverse impact will be the disturbance of the structure of seabed sediments in places where the hard bottom macrozoobenthos currently occurs (especially in the southern and north-eastern part of the sea area surveyed).

It should be noted that even if the impacts described here occur simultaneously, they will be shifted in time, e.g. a reduction of the suspended solids concentration in the water will be accompanied by a growth of the layer of sediments deposited.

6.1.1.4.1.3 Ichthyofauna

The main impacts on the ichthyofauna will be as follows:

- emission of noise and vibration;
- increased suspended solids concentration;
- release of pollutants and nutrients from sediments into water;
- habitat change;
- barrier creation.

Emission of noise and vibration

The main source of noise and vibration is the construction of foundations or support structures by piling. According to Popper and Hastings [334], this is the only noise impact, apart from underwater explosions, that can kill fish. The noise emitted during piling depends on the pile diameter and can reach from approx. 230 dB re: 1 μPa^2s (pile diameter of 1.5 m) [417] to nearly 260 dB re: 1 μPa^2s (pile diameter of 4.5 m) [285]. A slightly lower noise level should be expected during cable laying works (178 dB re: 1 μPa^2s) [453]. The range of this impact is highly dependent on noise intensity and seabed morphology, which may affect sound propagation.

Fish have acoustic stimulus receptors and their sensitivity to sound depends on the receptor structure. Species with an internal ear connected to the swim bladder (e.g. the clupeids) are capable of detecting sound pressure and hear sounds with the frequency of up to 3000−4000 Hz. Another group are fish without a swim bladder, capable only of sensing the movement of water particles generated by acoustic waves (e.g. adult flatfish). They can only detect sounds with a much lower frequency, not exceeding 500 Hz [333].

Depending on the intensity of noise and the distance from its source, the impact can have various effects, ranging from behavioural changes to the death of fish (Table 6.3).

Table 6.3. Potential impact of noise on ichthyofauna; based on Popper et al. [335]

Impact effect	Impact characteristics
Death	Death as a result of injuries caused by exposure to noise
Tissue damage; physiological disorders	Examples of injuries: internal haemorrhages; damage to gas-filled organs such as the swim bladder and surrounding tissues
Hearing system damage (TTS, PTS)	Hair cell damage, temporary (TTS) or permanent threshold shift (PTS) of hearing
Masking	Masking of important biological acoustic signals from the environment, including from other individuals
Behavioural changes	Disturbance of normal activities such as feeding, spawning, formation of shoals, migration, displacement from areas preferred, avoidance reaction

Thomsen *et al.* [417] suggest that the cod is able to detect sounds generated by piling at a distance of even 80 km, while salmon and flatfish can hear them from a distance of several kilometres.

A noise level higher than the normally prevailing in the environment may cause problems with detecting natural sounds, which in turn may cause problems with spatial orientation and locating prey (masking effect).

At the scale of local ichthyofauna communities, the disturbance of the normal noise level may lead to behavioural changes such as abandoning feeding grounds, hiding places and changing spawning grounds [380], thus affecting the survival of individuals and their reproductive success. Fish may react to increased noise levels by leaving the region affected (avoidance reaction) [298, 293, 11]. The avoidance effect may be particularly important in the case of spawning grounds, if there are no areas with equally favourable conditions for reproduction in the vicinity of the area abandoned. In experimental studies, Thomsen *et al.* [419] have shown that a sound of 144–178 dB re: 1 μPa^2s for sole and 140–161 dB re: 1 μPa^2s for cod caused an acceleration of movements in both species and a freezing reaction in cod. However, as this reaction lessens as a result of subsequent exposures to noise emission, the authors believe this may suggest a kind of acclimatisation to increased noise levels. The main spawning ground of cod (the Bornholm Basin) is located more than 90 km from the Baltic Power OWF Area, whereas in the case of sprat, the spawning area affected by the noise impact is relatively small compared to the spawning grounds found in the entire Southern Baltic. It should be added that a noise level exceeding 140 dB will not have its effect in the entire water column, but in acoustic channels. For example, in the north-western direction, at the distance of 80 km from the noise source, this noise level will occur at a depth of 40–60 m.

Other effects of fish exposure to an increased noise level may be a temporary (TTS) or permanent (PTS) threshold shift of their hearing. Tissues and the swim bladder may also be damaged and fish may die. Popper *et al.* [332] give a specific value of the noise level to be assumed as causing physical damage to fish. These authors follow the precautionary principle (assuming the TTS as a proxy of physical damage), and propose the assumption of the sound exposure levels (SEL) and the sound pressure levels

(SPL) of 187 dB re: 1 μPa^2 sec and 208 dB re: 1 μP, respectively, as the limit values above which physical damage may occur in fish. Similar values are provided by Woodbury and Stadler [467].

The table below (Table 6.4) prepared on the basis of the work of Popper *et al.* [335] and literature sources, presents intensity values of the sound generated during piling, causing various effects on fish with different structure of hearing organs.

Table 6.4. Impact of noise caused by pile driver operation on the ichthyofauna, taking into account the morphology and developmental stage [Source: Popper et al. [335]]*

Type of organism	Mortality and potential lethal damage	Renewing damage	Temporary threshold shift of hearing	Masking	Behavioural disturbances
Fish without a swim bladder (particle movement detection) e.g. flatfish	> 219 dB SELcum > 213 dBpeak	> 216 dB SELcum > 213 dBpeak	> 186 dB SELcum	(B) moderate (U) low (D) low	(B) high (U) moderate (D) low
Fish with a swim bladder not connected to the inner ear (particle movement detection) e.g. Atlantic salmon	210 dB SELcum > 207 dBpeak	203 dB SELcum > 207 dBpeak	> 186 dB SELcum	(B) moderate (U) low (D) low	(B) high (U) moderate (D) low
Fish with a swim bladder connected to the inner ear (acoustic pressure detection) e.g. Atlantic cod, herring	207 dB SELcum > 207 dBpeak	203 dB SELcum > 207 dBpeak	186 dB SELcum	(B) high (U) high (D) moderate	(B) high (U) high (D) moderate
Eggs and larvae	> 210 dB SELcum > 207 dBpeak	(B) moderate (U) low (D) low	(B) moderate (U) low (D) low	(B) moderate (U) low (D) low	(B) moderate (U) low (D) low

**For the impact effects for which it was impossible to determine the sound level, a relative risk (low, moderate, high) was determined depending on the distance from the sound source: (B) near – several dozen metres, (U) moderately far – several hundred metres, (D) far – several thousand metres. Units for peak values: dB re 1 μPa and for the cumulative SEL value: dB re 1 μPa^{2}s*

Models showing a maximum SEL range of 142 dB re: 1 μPa^{2}s for APV (NRS applied) predict that the range of impact causing behavioural changes will not exceed 87.9 km. In the case of noise and vibration causing TTS, the range will not exceed 0.1 km for a single strike and 29.5 km for a cumulative SEL within one hour (Table 6.5).

Moreover, the use of a “soft start” procedure, which is to scare the ichthyofauna away from the affected area before works begin, should additionally reduce the impact causing TTS. Consequently, the possibility of increased ichthyofauna mortality or tissue damage is not considered in the analysis.

Because of the prevailing hydrological conditions, the OWF Area is not a spawning ground of the cod or the deep-water spawning European flounder, which dominates in this area. During ichthyofauna surveys the sprat spawning was found, but this sea area is small in comparison with the large areas of the spawning grounds of pelagic fish. The presence of herring larvae in the vicinity of the project indicates that this species may spawn in this area. However, their number was very low compared to typical spawning grounds, so it can be assumed that possible disturbances of the reproductive process will not affect the recruitment of this species at the population level.

Table 6.5. Summary of distance ranges to threshold values for fish, obtained for the Baltic Power OWF using NRS [Source: Baltic Power Sp. z o.o. data]

Effect of factor impact		**SEL limit (dB re 1 μPa²s)**	**Impact range**	
			Average distance [km]	**Maximum distance [km]**
Fish without swim bladders	Behavioural response	142	26.1	50.2
	TTS (Single strike)	186	0.1	0.1
	TTS (1-h cumulative SEL)	186	10.8	29.5
	PTS (Single strike)	216	0.1	0.1
	PTS (1-h cumulative SEL)	216	0.1	0.1
Fish with swim bladders	Behavioural response	135	38.5	87.9
	TTS (Single strike)	186	0.1	0.1
	TTS (1-h cumulative SEL)	186	10.8	29.5
	PTS (Single strike)	203	0.1	0.1
	PTS (1-h cumulative SEL)	203	0.9	1.0

The impact of noise and vibration on adult fish will be negative, direct, short-term and reaching beyond the OWF Area (regional).

The sensitivity of the cod, herring and sprat to the impact was assessed as very high, while in the case of the European flounder, sand goby and common seasnail − as high.

The significance of the impact was assessed as moderate for all fish species examined. With regard to protected fish, only larval stages were found during the surveys, and for them the impact will be local in nature.

Increase in suspended solids content

During the dredging and installation works, sediments will be disturbed, which will result in an increased content of suspended solids in the water and deterioration of visibility. Such situations may occur mainly during the construction phase (the laying of foundations or support structures of wind power stations, and performance of excavations for cables) and during the decommissioning of the project (the removal of structural elements of the OWF).

The significance of the suspended solids impact on fish depends both on physical factors resulting from local conditions of the abiotic environment and those related to the biology of ichthyofauna.

The first group of factors includes sediment characteristics such as grain size distribution, mineral composition, adsorption and absorption capacity, hydrological parameters (salinity, temperature, oxygen concentration), seabed morphology or area hydrodynamics (direction of currents, waves) [116]. The effect of suspended solids on fish depends also on the content of suspended sediment and the exposure time on an organism [302]. It should be emphasised that the type of sediment is a very important factor affecting the intensity of the impact. In the case of sandy sediments, especially those with coarser grain-size distribution, both the spatial range and the impact time will be much lower than in the case of silty sediments or silty and sandy sediments.

The main biological factors that may affect impact intensity are the lifestyle, reproduction mode, developmental stage and condition of fish.

The impact of suspended solids on ichthyofauna may result in a whole range of negative effects, starting from avoidance reaction, through slower growth rate and reduced reproductive success, to increased mortality.

Early stages of fish development are particularly sensitive to the impact of increased suspended solids content. According to Engell-Sørensen and Skyt [116], in the case of juvenile and adult fish, the lethal effects of suspended solids may occur at a level of several grams per dm^3, whereas earlier developmental stages may react similarly to a level of several milligrams per dm^3. The higher sensitivity of juvenile stages is due to higher oxygen demand than in adult fish, associated with a higher rate of metabolism of juvenile stages [17, 316]. Suspended solid particles penetrating into the gills hinder the respiration process and may cause an increase in mortality rates [96].

The experimental studies showed the inhibition of herring larvae growth at suspended solids content above 500 mg dm^{-3}, whereas at the concentration of 19 g dm^{-3}, larvae mortality of 100% was observed [288]. Particularly high sensitivity is observed for the earliest developmental stages. Westerberg *et al.* [449] found an avoidance reaction for the cod larvae with yolk sac already at a suspended solids content of 3 mg dm^{-3}, whereas the values up to 10 mg dm^{-3} increased mortality rates.

The impact of increased suspended solids content may not only directly disturb the physiological processes of fish, but also affect their behaviour. The reduction in visibility caused by the presence of suspended solids lowers the efficiency of larvae sensing and consuming food [51]. This is confirmed by Utne-Palm research [430] showing that the increase in turbidity (80 JTU) has had a negative impact on the ability of herring larvae to obtain food.

For the earliest developmental stages, increased suspended solids content may have a negative impact on the growth and survival of roe. Sediment particles adhering to the chorion may limit gas exchange and the removal of metabolites [72, 215, 14]. Suspended solids content exceeding 100 mg dm^{-3} may result in increased mortality of cod roe [353]. In the case of pelagic roe, its buoyancy may also be reduced due to adhesion of sediment particles to its surface. This results in eggs falling to lower water levels or to the bottom. This may result not only in the deterioration of oxygen conditions, but also in an increase in the pressure of predation of benthic organisms and physical and physiological stress. According to Rönnbäck and Westerberg [353], a suspended solids content of 5 mg·dm^{-3} occurring for 4 days may cause cod roe to fall to the bottom.

In the case of demersal roe (spawned on the seabed), the negative impact of increased suspended solids content is much lower than in the case of roe developing in water. Research carried out by Messieh *et al.* [288] did not indicate any significant impact of suspended solids content of up to 7 g·dm^{-3} on herring roe. Similar conclusions were reached by Kiørboe *et al.* [216] during the experiments carried out for the suspended solids content of 300−500 mg·dm^{-3}. However, these authors suggested that the impact of the increased content of suspended solids may be significant in the event of a deterioration of oxygen conditions. Nevertheless, an indirect negative impact on herring reproduction cannot be excluded. De Groot [96] points to the possibility that individuals of this species may spawn in random places as a result of problems with finding traditional spawning grounds. Unless there is a clear negative impact of the increased suspended solids content on demersal roe, the harmfulness of covering the grains deposited on the sediment surface by a layer of particles undergoing sedimentation cannot be excluded. The limitation of visibility resulting in the loss of benthic vascular plants may also cause a deterioration of spawning conditions for certain fish species laying eggs on plants.

Increased suspended solids content rarely increases mortality of juvenile and adult ichthyofauna stages. This results from the possibility of active movement of fish to areas unaffected by this factor (avoidance effect). The values of suspended solids content that generate this effect vary depending on the species and developmental stage of fish. For young herrings, it was observed at 12 mg·dm^{-3} [288], whereas for adult fish the reaction was observed at a slightly lower level (10 mg·dm^{-3}) [204]. According to the Westerberg's research, referred to in the Environmental Impact Assessment Report for the Kriegers Flak Wind Farm [399], the avoidance reaction for herring and sprat was already observed at concentrations above 3 mg·dm^{-3}, whereas according to Hansson (quoted therein) such a reaction should be expected only at concentrations above 100 mg·dm^{-3}.

Apart from the avoidance reaction, effects of an increased suspended solids content such as disorientation, reduced response time, increased or reduced predation and disruption in food intake were also observed. A reverse reaction to avoidance responses is also possible for species which prefer an increased level of turbidity, limiting the pressure of predation [114, 218].

The data from literature mentioned above indicate an increase in fish larvae mortality at the suspended solids content of approx. 10 mg·l^{-1}. According to the results of the modelling calculations of suspended solids dispersion in the OWF Area, performed for GBS, such content may occur during the works related to the construction of the wind power station foundation or support structures on the seabed covered with cohesive soil under the most unfavourable conditions (an envelope of the maximum content for the entire simulation period) at a maximum distance of 1000 m from the place of the work performance. Assuming simultaneously conducted work on three foundations or support structures, the total impacted area should not exceed 10 km^2.

With reference to the pelagic roe, the negative impact of the suspended solids may occur at the content of 5 mg·l^{-1}. In the worst case scenario (depth 30 < h < 45 m, cohesive substrate, GBS diameter – 40 m), the impact of such content may cover the area of approx. 20 km^2 (estimated value) around the foundation or support structure location. Therefore, it can be assumed that while performing simultaneous work on three foundations or support structures (model assumptions assume the use of maximum three dredgers for the works), the increased mortality of pelagic roe may occur in the area of approx. 60 km^2. When assessing the significance of this impact, it should be taken into account, that during the surveys preceding the preparation of the report only relatively few instances of pelagic roe of sprat were found. The area affected by the negative impact of the suspended solids constitutes a very small part of the extensive sprat spawning ground, therefore, its importance for the population of this species is irrelevant.

An important factor determining the impact of the suspended solids is the duration of their increased content in water. The results of modelling indicate that the impact of suspended solids on the marine environment in the worst case scenario does not last longer than 64 hours counting from the moment of the commencement of work in the seabed on a single foundation or support structure. Therefore, such environmental impact will be short-term.

The re-deposition of suspended solids on the seabed leads to the seabed being covered with a new layer of sediment, the thickness of which, according to the modelling calculations, may reach several millimetres at a distance of 1000 m from the place of works. This may lead to a negative impact on the reproduction of the herring, common seasnail and gobies by covering the spawn laid by these species on the seabed. However, taking into account the small OWF Area, compared to the coastal areas and the nearby Słupsk Bank area, offering more favourable environmental conditions for spawning, a very local effect of the possible impact may be assumed.

Because of the prevailing hydrological conditions, the OWF Area is not a spawning ground of the cod or the deep-water spawning European flounder, which dominates in this area. During ichthyofauna surveys the sprat spawning was found, but this sea area is small in comparison with the large areas of the spawning grounds of pelagic fish. The presence of herring larvae in the project area indicates that spawning of this species may occur in this area. However, compared to typical spawning grounds, their population size was very low, so it can be assumed that any disturbances in the reproductive process will not affect the recruitment of this species at the population level.

The increase in suspended solids content will concern relatively small areas in relation to the entire surface of the spawning and feeding grounds. At the same time, the results of modelling of the suspended solids dispersion in the OWF Area indicate that the increase of their content in water will be short-term and local. The detailed results of the modelling of suspended solids dispersion are included in Appendix 2 to the EIA Report.

The impact related to the increase of suspended solids content will be negative, direct, local, and short-term.

The cod, European flounder, common seasnail and sand goby sensitivity to impact was assessed as moderate and for the sprat and herring – as large. The significance of the impact is assessed to be negligible for all the fish species analysed.

Release of pollutants and nutrients from sediments

The occurrence of pollutants and nutrients in water may result from a spillage as a result of a breakdown or collision of vessels, as well as through a release from the seabed sediments during the performance of works related to the construction of wind farms.

The greatest sensitivity of fish to harmful substances is observed in maturing females and early larval stages. The exposure of maturing females to even low concentrations of harmful substances may have an impact on their reproductive organs and the effects of which are often visible in the next generations. Morphological changes caused by this factor include deformations of the spine, jaws or reduction of the size of hatching larvae. Surveys carried out in the North Sea have shown the occurrence of morphological changes in species such as the common dab, European flounder, cod [102] and herring (*Clupea harengus membras*) [259].

Physiological changes as a result of the toxic substance impact most frequently include the reduced pulse and hormonal disorders that may affect ovulation and spawning. There may also be behavioural disorders resulting in reduced feeding efficiency [355, 394, 444]. A potential high threat may be caused by the emission of oil derivatives (hydrocarbons), including PAHs, however, light fractions cause a much higher threat than heavy ones. In the case of juvenile stages, a clear negative impact of even low concentrations of PAHs on embryonic growth was identified [82]. However, according to the U.S. National Oceans and Atmosphere Administration (NOAA), the impact of oil derivatives on fish is largely limited to coastal and closed sea areas where active risk avoidance is hindered. Also, the surveys of Koehler [223] and Vethaak and Wester [437] have not shown a statistically significant link between the PAH concentrations and the occurrence of liver tumours in the flounder in Danish and German waters of the North Sea, although the researchers did not exclude the possibility of tumours being triggered by these substances [223, 436].

Toxic chemicals may be released from the sediment during works on the foundations or support structures of wind power stations, laying power cables on the seabed and decommissioning of the OWF structures. According to the Helsinki Commission, harmful substances that may penetrate sediment water include heavy metals (cadmium, chromium, copper, lead, mercury, nickel, zinc, and arsenic), chlorinated biphenyls, chloro- and phospho-organic pesticides, TBT and its decomposition products, the sum of hydrocarbons, polychlorinated dibenzodioxins, polychlorinated dibenzofurans and PCBs. However, the risk of larger amounts of these substances being released from the sediments in the Polish Exclusive Economic Zone appears to be low due to their low concentrations found in the sediments of the Southern Baltic area.

Tests of the PCBs, organochlorinated pesticides and heavy metals (copper, zinc, cadmium, lead, and mercury) content in sediments from different PMA locations did not show the presence of the above substances in sediments in the concentrations which could cause a negative biological effect [88]. Tests of the concentrations of heavy metals (copper, zinc, cadmium, lead, and mercury) in the sediments and the tissues of the European flounder from the area concerned, carried out in 2011, indicate a low level of accumulation of harmful substances in fish tissues [330]. Also during the tests on DDT, HCB, polychlorinated dibenzodioxins and dibenzofurans content in the sediments of the Southern Baltic, no concentrations of these pollutants that may have toxic effects on marine organisms were found [403].

The impact related to releasing pollutants and nutrients from the sediments into water will be negative, direct, temporary and local.

The cod, European flounder, common seasnail, sand goby, sprat and herring sensitivity to impact was assessed as moderate.

The significance of the impact is assessed to be negligible for all the fish species examined.

Habitat change

During the performance of work at the construction stage, there may be a temporary, significant reduction in the availability of the project area for fish. If this area is an important spawning ground, such exclusion, even of a small area, may be important for the greater part of the sea area [30]. The scale of the impact of loss is specific to individual taxa and the life stages of fish [457]. Moreover, the following factors seem to be equally decisive, the size of the area lost, the season in which works are carried out and their duration.

Physical changes in the environment may directly affect living and reproductive conditions, causing disturbance or cessation of reproduction [191, 192, 327, 336, 39]. Changes in the sediment structure may have a negative impact on the reproduction of fish species laying demersal roe. Such a reaction may, for example, concern herrings requiring a seabed covered with sediment allowing the attachment of eggs [216, 336].

Changes in the physical parameters of sediment or occupation of the seabed surface by structural elements may result in loss of habitat for some benthic organisms and, consequently, in the reduction of the food supply for benthivorous fish.

The sensitivity of the ichthyofauna to the loss of habitat, which may occur during the construction of the hard substrate elements on the seabed, is specific to individual fish species and life stages of fish. This is related to different habitat requirements of a given developmental stage and a given species [457]. The scale of impact is influenced by the size of the area lost as well as the duration and season in which the works are carried out.

A change of habitat during construction will lead to the complete destruction of benthos in the areas of excavations for foundations or support structures and cable trenches. This will result in a depletion of food supply for benthivorous fish. However, the area at which the habitat change will completely eliminate benthic organisms will probably be relatively small. Given the active movement of fish in search for food, this loss of organisms comprising the benthivorous fish diet can be considered insignificant.

Also, the potential reduction of fish food supply caused by the negative impact on zoobenthos caused by the increase in suspended solids concentration in water and the seabed being covered with a layer of fine sediment deposited from the water will probably be insignificant. The assessment of the sensitivity of zoobenthos to both factors was assessed as low and the significance of their impact was negligible.

The OWF Area is neither a spawning ground for the cod nor for the deep-water spawning European flounder dominant in this area. During ichthyofauna surveys the sprat spawning was found, but this sea area is small in comparison with the large areas of the spawning grounds of pelagic fish. Herring spawning may occur in the OWF Area, but it may be assumed that any disturbances in the reproductive process will not affect the recruitment of this species at the population level.

The impact was considered as long-term and related to relatively small areas in comparison with the entire area of the spawning and feeding grounds.

The impact related to the change of habitat will be negative, direct, temporary and local.

The cod, European flounder, common seasnail, sand goby, sprat and herring sensitivity to the impact was assessed to be high. The significance of the impact was assessed as negligible for all the fish species examined.

Barrier creation

The construction of underwater structures may constitute a barrier for fish whose migration routes may run in this area. Intense maritime traffic during the construction period may also reinforce the effect. The observations carried out in the areas of the Danish OWFs indicate that due to the possibility of an active movement of fish, these factors do not significantly disturb migration processes [251]. The scale of the impact will probably be local and short-term, causing only temporary avoidance of the area during the performance of works.

The density of OWPS structures is so low that it will not affect the migration possibilities of ichthyofauna.

The impact related to the creation of the barrier will be negative, direct, local and temporary for the cod and European flounder, being long-term and permanent for other fish species.

The cod, European flounder, common seasnail, sand goby, sprat and herring sensitivity to impact was assessed as moderate. The significance of the impact is assessed to be negligible for all the fish species examined.

6.1.1.4.1.4 Marine mammals

At the construction stage of the Baltic Power OWF, marine mammals may be subject to impacts resulting from:

- underwater noise from piling works;
- noise generated by vessel traffic;
- increased content of suspended solids in water;
- habitat changes;
- spillage of oil derivatives into the environment as a result of vessel breakdowns.

Piling noise

The rare occurrence **of grey seals** in the area surveyed (subsection 3.7.1.4) [178] and the relatively small range of impact calculated (Appendix 3 to the EIA Report, subsection 4.2) indicate that the number of individuals affected by the impact of the Baltic Power OWF construction is low, except for the impact in the form of TTS due to the cumulative pile-driver strikes, which may affect the animals for a short-time at a distance of up to 59 km from the piling works. In this case, the impact on the population will be moderate.

The total number of harbour seals in the Baltic Sea is low, with an estimated population of 1563 individuals in the south-western part of the Baltic Sea (NOVANA, Jonas Teilman, personal communication) and approx. 1200 individuals calculated in the Kalmarsund population [178]. Most seals in the south-western Baltic Sea gather in Falsterbo, Saltholm and Bøgestrømmen, far west of the Baltic Power OWF project areas. Seals of the Kalmarsund population can be found closer to the Baltic Power project areas, but usually they do not move more than 50−100 km from their permanent occurrence sites (laying grounds) [308], therefore, impacts from single pile driver strikes and permanent shift of the hearing threshold due to the cumulative noise from 1 hour of piling are of little importance. On the other hand, the impact in the form of TTS due to the cumulative pile-driver strikes may be of moderate importance for the harbour seal.

In order to estimate the percentage **of porpoises** affected by the Baltic Power OWF construction impacts, modelled impact areas were used (Appendix 3 to the EIA Report, subsection 4.2). Their dimensions were determined by the maximum impact ranges. The number of animals affected was then estimated on the basis of SAMBAH estimates of porpoise density. Due to the very large variability of estimates, the lower and upper limit of confidence provided by SAMBAH (0.00060−0.00823 individuals/km^2) were used [364]. The proportion of animals affected within the population was calculated by dividing the number of porpoises in the area affected (lower and upper confidence limit) by the overall population size (corresponding to lower and upper confidence limit) (95% CI 80–1091) [364]. The results are shown in the table (Table 6.6). It can be noted, that regardless of which confidence levels are used in the calculations, these animals are almost not affected by TTS and PTS from a single pile-driver strike, indicating a low significance of the impact on the porpoise population. After 1 hour of piling noise exposure (SEL_{cum}), the percentage of populations affected by TTS and PTS is higher than the population affected by TTS and PTS from a single pile-driver strike. Up to 2% of the porpoise population may be affected by the PTS for the cumulative SEL, which has a significant impact on the population due to its long-term impact. For TTS with SEL_{cum}, the percentage increases to 9% of the population, which is moderate due to its reversible and short-term nature.

After the application of NRS, the values decreased. This is particularly relevant for the impacts which have been assessed as significant for the scenario in which mitigation measures are not applied. The proportion of animals affected by TTS and PTS after the application of NRS has been reduced to 0−1% (Table 6.6), which in the worst case scenario changed the impact assessment to moderate (Table 6.7).

Table 6.6. Proportion of porpoises affected in the Baltic Power OWF Area without and with the noise reduction system (NRS) applied. The number of individuals within the population is above and below 95% of the population size estimated together with its density as part of the SAMBAH project [364] [Source: Baltic Power Sp. z o.o. data]

Effect	**Impact area [km²]**		**Estimated number of individuals in the Baltic population [NE]**	**Estimated density in the area modelled [sp. km⁻²]**	**Without NRS**		**With NRS**	
	Without NRS	**With NRS**			**Number of porpoises affected in the area modelled**	**Percentage of porpoises affected in the population [%]**	**Number of porpoises affected in the area modelled**	**Percentage of porpoises affected in the population [%]**
PTS (single strike)	4	0.03	80–1091	0.00060–0.00823	0	0	0	0
PTS (1-h cum)	2580	203	80–1091	0.00060–0.00823	2/21	1.94/1.95	0/2	0/0
TTS (single strike)	161	5	80–1091	0.00060–0.00823	0/1	0/0	0	0
TTS (1-h cum)	12 100	1020	80–1091	0.00060–0.00823	7/100	9.08/9.13	1/8	0.77/0.77
Behavioural response	6030	552	80–1091	0.00060–0.00823	4/50	4.52/4.55	0/5	0/0

Noise caused by vessel traffic

Small, fast ships, such as barges and delivery ships, generate noise mainly with frequencies from < 1 kHz to > 10 kHz [111, 182]. It is likely that their movement will lead to an increase in the acoustic field during the construction phase, including the frequencies that partly concern marine mammals [182]. Porpoises, grey seals and harbour seals are more sensitive to higher frequencies and studies have shown that porpoises react to lower levels of high frequencies of vessel noise components [111, 462]. Wiśniewska [462] also discovered that exposure to sudden high-frequency noise, which could be caused by a fast-moving vessel, resulted in a vigorous caudal fin waving, disturbance to feeding and even occasionally cessation of echolocation in the case of free-living porpoises. These behavioural changes were observed at a distance of several kilometres from the vessel. Increased noise from vessels related to the construction phase may, thus, pose a potential problem for animals, and the presence of vessels in the area may result in porpoises migrations or incurring energy expenditure due to the reduction of feeding ground and the need to move away from the vessel. The intensity of disruptive factors depends on the type and number of vessels, which in this case will be small- or medium-sized, such as maintenance vessels, construction vessels and crane vessels.

Given that some of the areas with the greatest vessel traffic in Danish waters are also areas with many porpoises [398], they are very often exposed to low level of ship noise [462]. However, any movements of porpoises caused by noise related to vessel traffic will be short-term and at relatively short distances (<10 km). The same applies to the two seal species in question, as seals are also often observed in areas with high vessel traffic intensity [205].

Ambient noise levels should not increase significantly due to the increased traffic of shipping related to the construction phase. This will be a short-term impact. Therefore, the noise caused by the vessel traffic was assessed as insignificant despite its direct nature.

Increase of suspended solids in water

It is expected that the suspension of sediments related to the construction will be short-term; therefore, it will probably not affect porpoises, grey seals and harbour seals. The increase in pollutant concentration as a result of suspended sediments is likely to be of low significance.

Habitat change

Habitat change related to construction include changes of the seabed and increasing presence of vessels at the water surface, which indirectly affects marine mammals. None of these changes will have a significant impact compared to the impact of the noise generated during the construction phase. The significance of this factor for porpoises and seals has been assessed to be low.

Spillage of oil derivatives into the environment as a result of vessel breakdowns

Vessel collisions causing oil spillage in the project area may adversely affect marine mammals present in adjacent waters. However, fuel spillage is very unlikely. Taking this into account, the significance of this factor for porpoises and seals was assessed as moderate.

Assessment of the significance of impacts during the construction phase

For the assessment of impacts, the methodology developed for the purposes of the EIA Report was adopted. The significance of the impact of the Baltic Power OWF was assessed for the construction phase after the application of NRS. The results are presented in the table below (Table 6.7). The basis for the assessment were the results of numerical modelling, included in Appendix 3 to the EIA Report.

After the application of the NRS, all impacts on porpoises, grey seal and harbour seal were assessed to be of low or moderate significance.

Table 6.7. Significance of the impact on marine mammals resulting from piling during the construction phase after application of NRS [Source: Baltic Power Sp. z o.o. data]

Species	Impact	Impact description	Impact significance
Harbour porpoise *Phocoena phocoena*	PTS (single strike)	Permanent shift in the hearing threshold due to a single hammer strike	Low
	PTS (1-h cum)	Permanent shift in the hearing threshold due to accumulated noise from 1 hour of piling	Moderate
	TTS (single strike)	Temporary shift in the hearing threshold due to a single hammer strike	Low
	TTS (1-h cum)	Temporary shift in the hearing threshold due to the accumulated noise from 1 hour of piling	Moderate
	Behavioural response	Behavioural response to pile driving (moving away from the construction site)	Moderate
	Shipping noise	Behavioural response to shipping noise (moving away from the construction site)	Low
	Suspended sediments	Changes in behaviour caused by the suspension of sediments released during construction	Low
	Habitat change	Changes in behaviour caused by habitat change resulting from the construction	Low
	Vessel collisions	Contamination caused by collision of vessels used for construction (e.g. fuel spillage)	Moderate
Grey seal *Halichoerus grypus*	PTS (single strike)	Permanent shift in the hearing threshold due to a single hammer strike	Low
	PTS (1-h cum)	Permanent shift in the hearing threshold due to the accumulated noise from 1 hour of piling	Low
	TTS (single strike)	Temporary shift in the hearing threshold due to a single hammer strike	Low
	TTS (1-h cum)	Temporary shift in the hearing threshold of hearing due to the accumulated noise from 1 hour of piling	Moderate
	Behavioural response	Behavioural response to pile driving (moving away from the construction site)	Low
	Shipping noise	Behavioural response to shipping noise (moving away from the construction site)	Low
	Suspended sediments	Changes in behaviour caused by the suspension of sediments released during construction	Low
	Habitat change	Changes in behaviour caused by habitat change resulting from the construction	Low
	Vessel collisions	Contamination caused by collision of vessels used for construction (e.g. fuel spillage)	Moderate
Harbour seal *Phoca vitulina*	PTS (single strike)	Permanent shift in the hearing threshold due to a single hammer strike	Low
	PTS (1-h cum)	Permanent shift in the hearing threshold due to the accumulated noise from 1 hour of piling	Low
	TTS (single strike)	Temporary shift in the hearing threshold due to a single hammer strike	Low

Species	Impact	Impact description	Impact significance
	TTS (1-h cum)	Temporary shift in the hearing threshold due to the accumulated noise from 1 hour of piling	Low
	Behavioural response	Behavioural response to pile driving (moving away from the construction site)	Low
	Shipping noise	Behavioural response to shipping noise (moving away from the construction site)	Low
	Suspended sediments	Changes in behaviour caused by suspension of sediments released during construction	Low
	Habitat change	Changes in behaviour caused by habitat change resulting from the construction	Low
	Vessel collisions	Contamination caused by collision of vessels used for construction (e.g. fuel spillage)	Moderate

6.1.1.4.1.5 Migratory birds

During the construction phase of the OWF, the space above the sea area where installation and construction works are carried out is gradually disturbed. Both the vessels participating in these works and the OWF structures erected create obstacles for migratory birds. Moreover, taking into account the parameters of bird passages, i.e. their altitude and direction, the impact on different bird species will have different significance. This assessment primarily accounted for the presence of construction vessels during the conduct of work. Impacts on migratory birds resulting from the barrier effect and collision with the Baltic Power OWF structures were assessed for the exploitation phase, when their effects are the greatest. Detailed assessment of the impact of the Baltic Power OWF during the construction phase on migratory birds is included in Appendix No to the EIA Report.

The significance of the impact of the Baltic Power OWF, i.e. the barrier effect and the risk of collision on migratory birds during the construction phase was assessed to be low at most.

6.1.1.4.1.6 Seabirds

Identification of key factors affecting seabirds during the construction phase

The impact of the planned project during the construction phase will be mainly local, i.e. limited to the construction site; the Baltic Power OWF will be located outside the boundaries of protected areas, including the Natura 2000 sites.

In order to determine the significance of the impact, the scale of the impact was assessed as high for the long-tailed duck and velvet scoter, moderate for the razorbill and the common guillemot, and as insignificant for the European herring gull.

The factors identified and the assessment of their impact on marine avifauna during the construction phase are presented below.

Vessel traffic

Construction works will require the presence of various types of vessels which will disturb seabirds by their physical presence, noise (including the noise generated by pile driving, if pile-based foundations are chosen) as well as light emission. The first two factors should not affect the change of the flight routes of those species of seabirds that do not use the area, but only fly over it (e.g. the common scoter). However, it cannot be excluded that such impact will occur at night, especially when the construction site is heavily illuminated. As birds migrate, they navigate according to natural light sources such as stars and the sun. It has been noticed that at night they also head towards lighthouses, oil rigs and other structures illuminated by artificial light [451]. The range of impact will depend on the number of vessels involved, their size, the manner of vessel illumination and the intensity of light sources. The duration of the construction phase and the location of the power stations within the OWF Area where the increased vessel traffic will take place also play a part. The period in which the works will take place is important as most seabird species, including the long-tailed duck, exhibit significant differences in abundance in various phenological periods. The deterring effect will increase with the progressing development of the OWF Area. Initially, it will be local and birds will be able to find feeding grounds in the vicinity (e.g. in the neighbouring Natura 2000 site of the Słupsk Bank). However, late in the construction phase the range of this impact will increase significantly, strongly limiting feeding and resting possibilities for birds in the OWF Area.

On the other hand, the presence of vessels and fixed structures protruding from the water will result in a greater abundance of gulls that use such elements as resting sites and seek food in the vicinity of the vessels. Three species of large gulls, including the European herring gull most abundant there, gather in the open sea around fishing vessels. If commercial fishing is reduced in this sea area during construction (or future exploitation), these gulls will move (at least partially) to other fishing sites.

Vessel traffic during the construction phase will cause a direct negative impact on seabirds, of local character (regional in the case of the long-tailed duck due to the possible impact on the biogeographical population of the species). For the razorbill, common guillemot, European herring gull and velvet scoter, this is a medium-term impact and for the long-tailed duck – short-term and temporary.

The sensitivity to the impact on the European herring gull was assessed as low and for other species as high.

The significance of the impact varies for individual species and is assessed as negligible for the European herring gull, moderate for the razorbill and common guillemot, and high for both species of ducks, the long-tailed duck and the velvet scoter.

Emission of noise and vibration

The presence and traffic of construction vessels will be the main cause of disturbance of seabirds in the sea area covered by the construction of the Baltic Power OWF. This impact will be much higher than other pressures related to the construction phase, such as underwater noise emission.

The monitoring of birds during the construction works of the Egmond aan Zee OWF in the Netherlands did not show any noticeable reaction of bird species insensitive to the disturbances related to the presence of vessels (mainly gulls and terns) to piling [253].

The environmental impact assessment for the OWF Area indicated the presence of a possible significant impact of underwater noise on fish which constitute the food supply for certain species of seabirds (diving piscivorous birds). The application of NRS along with a mitigation measure (soft-start procedure during piling) will minimise the negative impact.

Noise and vibration during the construction phase are direct negative impacts on seabirds of local range (for the long-tailed duck of regional range, due to possible impact on the biogeographical population of this species), medium-term, reversible, repeatable during the construction phase, with intensity depending on the species.

The sensitivity to the impact for the European herring gull was assessed as low and for other bird species as high.

The significance of the impact varies for individual species and is assessed as negligible for the European herring gull, moderate for the razorbill and common guillemot, and high for both duck species, the long-tailed duck and the velvet scoter.

Lighting of the project site

When migrating, birds navigate according to natural light sources such as stars and the sun. It has been noticed that at night they also head towards lighthouses, oil rigs and other structures illuminated by artificial light [451]. Surveys on the behaviour of birds near oil rigs have shown that lighting causes seabirds to gather around these structures not only during the migration period. This is mostly the case for tubenoses (*Procellariiformes*) which are most often active at night, but the concentrations of the little auk (*Alle alle*) have also been observed [451], this species being closely related to the razorbill and the guillemot found in the area of the planned project. However, in the case of most typical seabirds species (sea ducks, gaviiformes), the impact of artificial lighting on birds present in the immediate and further vicinity of light sources remains very poorly explored.

Lighting of the project site during the construction phase will cause a direct negative impact on seabirds, of local range (regional for the long-tailed duck, due to possible impact on the biogeographical population of this species), medium-term, reversible, repeatable during the construction period, with intensity depending on the species.

The sensitivity to the impact was assessed as low for the European herring gull and for other species as high.

The significance of the impact varies for individual species and is assessed as negligible for the European herring gull, moderate for the razorbill and common guillemot and high for both duck species, the long-tailed duck and the velvet scoter.

Barrier creation

The structures of the power station, gradually appearing during the construction phase, will deter birds. The influence of this impact on birds depends on the progress of constructing the OWF. Initially, individual wind power stations will have little impact on birds, but the deterring effect will gradually increase [390]. The data from literature clearly indicate that seabirds avoid areas occupied by wind power stations and their population decreases within a radius of up to 2 or even up to 4 km [76, 323, 254, 235]. Adult birds will most likely be able, to some extent, to become acclimatised to the presence of wind farms. However, individuals undertaking their first migration towards wintering grounds may have problems with passing through an extensive barrier created by a group of wind farms. This may result from their lesser experience, which causes higher bird mortality in the first year of life [80, 341, 273]. Lack of data on bird behaviour in the vicinity of extensive OWFs indicates the necessity to plan post-investment monitoring surveys. It should also be noted that the parameter affecting the level of impact is the number of wind power stations constructed. The distance between individual wind power stations on the farm and the neighbouring OWFs is also important. Both the construction and exploitation of wind power stations located close to the Baltic Power OWF will result in the accumulation of the barrier effect for birds.

In addition, the presence of numerous vessels used for the OWF construction may result in an additional barrier effect, thus reducing the possibility of birds moving between the resting areas during the migration. The scale of the impact will depend on the number of vessels involved in the construction phase, their size, the duration of the construction phase and the phenological period in which the works will be carried out.

The sensitivity to the impact for the European herring gull was assessed as low and for other species as high.

The significance of the impact varies for individual species and is assessed as negligible for the European herring gull, moderate for the razorbill and common guillemot, and high for both duck species, the long-tailed duck and the velvet scoter.

Collisions with vessels

Collisions between birds and vessels used for the OWF construction may occur, mainly at night, when birds are attracted by the light emitted. The scale of the impact will depend on the number of vessels involved in the construction phase, their size, lighting configuration and intensity, the duration of the construction phase and the phenological period in which the works will be carried out.

The sensitivity to the impact for the European herring gull was assessed as low and for other species as high.

The significance of the impact of collisions with vessels varies for individual species and is assessed as negligible for the European herring gull, moderate for the razorbill and common guillemot, and high for both duck species, the long-tailed duck and the velvet scoter.

Destruction of benthic habitats

Construction of foundations or support structures (especially if GBS foundations are selected) and laying of inner-array power cables will result in numerous disturbances of seabed communities at the project site.

Some of the habitats used by seabirds stopping during migration will be lost due to the construction of foundations or support structures. This process will have a direct impact on the seabed and will impact the water column. Natural benthic environments will be lost, but most likely they will be replaced by new ones (artificial reef effect). The range of impact will mainly depend on the number of foundations or support structures of wind power stations as well as their type and size.

Bird species exposed to impacts related to the loss of benthic habitats as a result of space occupation are mainly the benthivorous sea ducks. However, those species are very sensitive to disturbance caused by vessel presence and other human activities at sea. Therefore, it is estimated that the deterring impact due to the presence of construction vessels will be the main impact in the area, which will result in the movement of the sensitive species to other areas. Thus, those birds will not experience an additional impact related to space occupation during the construction phase.

The destruction of benthos habitats during construction works is an indirect negative impact on some seabirds (mainly benthivorous species), which is local, medium-term, reversible, repeatable during the construction period (for each wind power station or infrastructure component), with intensity depending on the species.

The sensitivity to the impact was assessed as negligible for the European herring gull, moderate for the razorbill and the common guillemot, and high for the long-tailed duck and the velvet scoter.

The significance of the impact varies for individual species and was assessed as negligible for the European herring gull, low for the razorbill and common guillemot, and as high for both duck species, the long-tailed duck and the velvet scoter.

Increase of suspended solids content in water and deposition of disturbed sediment

These factors may affect the ability of diving benthivorous and piscivorous species to obtain food.

During the OWF construction, the seabed sediments will be disturbed and the concentration of suspended solids in water will increase. That phenomenon will be the most intense if GBSs are used, which require prior preparation of the seabed.

Direct transfer of sediments and their resuspension will result in reduced water transparency. If it exceeds the natural level, it could cause difficulties in hunting for birds that use their sight when searching for food (gaviiformes, sea ducks, razorbills), and thus, result in the movement of birds preferring more transparent waters. No impact on birds feeding on the water surface (gulls) is expected.

The local decrease in water transparency in the OWF Area will be short-term and its impact will be eliminated by other, more intense disturbances causing birds to leave the area.

Sediment deposition related to the preparation of the seabed for foundations or support structures of wind power stations may affect benthic environments located in the OWF Area and in its vicinity. A layer of sediments that have been disturbed will be deposited on benthic organisms, which may hinder the possibility of gas exchange by these organisms and their intake of nutrients. This phenomenon may lead to a reduction of benthic resources and fish that feed on them (reduction of biomass, reduction of growth and productivity), and consequently may affect the food supply for seabirds in this area.

The increased content of suspended solids in water during the construction works and the deposition of sediments that have been disturbed are indirect negative impacts on seabirds (diving in water in search of food), which are local, medium-term, reversible, repeatable during the construction period, with low intensity.

The sensitivity to the impact for the European herring gull was assessed as negligible, for the razorbill and the common guillemot as moderate, and for the long-tailed duck and velvet scoter as high.

The significance of the impact varies for individual species and is assessed as negligible for the European herring gull, moderate for the razorbill and common guillemot, and high for both duck species, the long-tailed duck and the velvet scoter.

The table below (Table 6.8) presents a summary of the significance of individual impacts of the Baltic Power OWF on seabirds during the construction phase.

Table 6.8. Significance of the project impact on seabirds during the construction phase [Source: Baltic Power Sp. z o.o. data]

Species	**Impact**	**Impact description**	**Impact significance**
European herring gull *Larus argentatus*	Vessel traffic	Disturbance of the species as a result of transport to and from the project site and as a result of construction works, operation of machines and equipment necessary for the implementation of the project	Negligible
	Emission of noise and vibration	Presence and movement of construction vessels	Negligible
	Lighting of the project site	Attracting and concentrating birds around the project	Negligible
	Collisions with vessels	Attracting birds to vessels at night and collisions with vessels	Negligible
	Barrier creation	Barrier creation by the structures of subsequent wind power stations	Negligible

Species	Impact	Impact description	Impact significance
	Destruction of benthic habitats	Loss of habitats due to the installation of foundations or support structures	Negligible
	Increase of suspended solids content in water and deposition of disturbed sediment	Disturbance of seabed sediments, especially with the use of gravity-based structures (GBS)	Negligible
Razorbill *Alca torda*, Common guillemot *Uria aalge*	Vessel traffic	Disturbance of the species as a result of transport to and from the project site and as a result of construction works, operation of machines and equipment necessary for the implementation of the project	Moderate
	Emission of noise and vibration	Presence and movement of construction vessels	Moderate
	Lighting of the project site	Attracting and concentrating birds around the project	Moderate
	Collisions with vessels	Attracting birds to vessels at night and collisions with vessels	Moderate
	Barrier creation	Barrier creation by the structures of subsequent wind power stations	Moderate
	Destruction of benthic habitats	Loss of habitats due to the installation of foundations or support structures	Low
	Increase of suspended solids content in water and deposition of disturbed sediment	Disturbance of seabed sediments, especially with the use of gravity-based structures (GBS)	Low
Velvet scoter *Melanitta fusca*	Vessel traffic	Disturbance of the species as a result of transport to and from the project site and as a result of construction works, operation of machines and equipment necessary for the implementation of the project	High
	Emission of noise and vibration	Presence and movement of construction vessels	High
	Lighting of the project site	Attracting and concentrating birds around the project	High
	Collisions with vessels	Attracting birds to vessels at night and collisions with vessels	High
	Barrier creation	Barrier creation by the structures of subsequent wind power stations	High
	Destruction of benthic habitats	Loss of habitats due to the installation of foundations or support structures	High
	Increase of suspended solids content in water and deposition of disturbed sediment	Disturbance of seabed sediments, especially with the use of gravity-based structures (GBS)	High

Species	Impact	Impact description	Impact significance
Long-tailed duck *Clangula hyemalis*	Vessel traffic	Disturbance of the species as a result of transport to and from the project site and as a result of construction works, operation of machines and equipment necessary for the implementation of the project	High
	Emission of noise and vibration	Presence and movement of construction vessels	High
	Lighting of the project site	Attracting and concentrating birds around the project	High
	Collisions with vessels	Attracting birds to vessels at night and collisions with vessels	High
	Barrier creation	Barrier creation by the structures of subsequent wind power stations	High
	Destruction of benthic habitats	Loss of habitats due to the installation of foundations or support structures	High
	Increase of suspended solids content in water and deposition of disturbed sediment	Disturbance of seabed sediments, especially with the use of gravity-based structures (GBS)	High

6.1.1.4.1.7 Bats

During the construction phase, the following activities shall be performed which may directly or indirectly affect migratory bats:

- allocation of installation/transport vessels including structural components to the construction site;
- seabed preparation for foundations or support structure components;
- embedding of foundations or support structure components;
- installation of individual components of wind power stations (towers, nacelles, rotors);
- cable laying (burying cables in the seabed or laying them on the seabed).

Works taking place under the sea surface do not have a direct impact on bats. However, as a result of these works, vessel traffic in the OWF Area as well as light and noise emissions will increase. Migratory bats may be attracted by the vessel and construction site lighting [329]. Surveys on the feeding and migratory behaviour of bats off the coast of Sweden and Denmark have provided evidence of the presence of at least 11 species of bats over the sea area [2]. They have revealed that both seasonal migratory bats and settled species feed above the sea area. Based on surveys (Ahlen et al. [2]) carried out off the Swedish coast, it has been found that feeding was common in areas with a high density of insects on the water surface. No correlation was found between the concentration of food supply and the distance from the shore. Most likely, the concentration of food supply depends on weather conditions. According to literature [361, 54], concentrations of insects can move actively or passively through wind.

During the construction phase, vessels and newly erected structures may serve as shelters or resting places for migratory bats [2, 362]. In this case, there may be a risk of collision with vessels and structural components in the development area.

Due to construction works and increased vessel traffic in the vicinity, noise levels will increase. The noise increase may cause the dispersion of bats during flight and act as a barrier effect. Therefore, noise may cause bats to change their flight direction, which in turn means extra energy expenditure [128].

Surveys conducted during the spring and autumn migration periods indicated a possibility of bats migrating through the OWF Area, but the migration intensity was low due to the low activity of bats.

The impacts on bats identified for the construction phase will be negative, direct, local and short-term.

The sensitivity to the impact was assessed as low, whereas the significance of the Baltic Power OWF impact during the construction phase was assessed as negligible due to the low activity of bats found during the surveys carried out in the seasonal migration periods.

6.1.1.4.2 Impact on protected areas

6.1.1.4.2.1 Impact on protected areas other than Natura 2000

Given the location of the Baltic Power OWF at a significant distance from the protected area of the Słowiński National Park, there will be no significant impact on this area, including any element for which it was established, such as biodiversity, resources, objects and elements of inanimate nature and the landscape of the Park.

In the Appendix to the Ordinance of the Minister of the Environment of 16 February 2017 on the protection tasks of the Słowiński National Park (Official Journal of the Ministry of the Environment of 2017, item 10, as amended), in which the existing and potential internal and external threats and methods of elimination or mitigation of these threats and their effects were identified and assessed, the existing external threats category indicates the risk resulting from increasing the areas for wind farm construction in the municipalities adjacent to the Park. In the category of potential external threats, only the construction of wind farms in the buffer zone of the Park was indicated as constituting a potential external threat and therefore, it should be stated that the Baltic Power OWF will not pose a threat to the Słowiński National Park.

6.1.1.4.2.2 Impact on Natura 2000 sites

Identification and assessment of impacts on protected areas within the European Natura 2000 network is presented in subsection 6.3.

6.1.1.4.3 Impact on wildlife corridors

Pursuant to the Nature Conservation Act of 16 April 2004 (Journal of Laws of 2016, item 2134, as amended), a wildlife corridor is an area allowing for migration of plants, animals or fungi. The network of wildlife corridors connecting the European Nature Protection Network Natura 2000 in Poland was established in 2011 [201]; wildlife corridors were not identified in the PMA. Regular migrations of birds take place in the Baltic Sea area in spring and autumn; however, the migration tactics and their routes are very poorly recognised.

In case of the velvet scoter, the long-tailed duck and the razorbill, an increase in the number of migrating individuals in the spring period ran parallel to the significant presence of these species on the water in the area of planned Baltic Power OWF. Also, an increase in the number of individuals of these species passing through in the autumn period ran parallel to an increase in their number in the sea area surveyed. Therefore, it can be assumed that some of the observed flights of the long-tailed duck, velvet scoter and razorbill, even in the period of spring and autumn migrations, concerned local passages between feeding grounds [27].

Given the lack of information on the occurrence, functioning and significance of wildlife corridors in maritime areas, it was conservatively assumed that the value of this resource is medium. Taking into account the spatial scale of the Baltic Power OWF Area in relation to the size of the Baltic maritime area, including the increasing effect of spatial development, it was assessed that the impact of the Baltic Power OWF on the potential migration routes of migratory species will be negligible during the construction phase.

6.1.1.4.4 Impact on biodiversity

Macrozoobenthos

Disturbance of the seabed sediments structure will result in the physical destruction of the macrozoobenthos complex only at 1.97% of the OWF Development Area, at the location of foundations or support structures and along the cable routes inside the OWF. However, this will not result in a significant change in the quality structure of the soft bottom macrozoobenthos communities, consisting of taxa typical and common in the open waters of the Southern Baltic.

Ichthyofauna

Impacts occurring during the construction phase may reduce the diversity of ichthyofauna through the fish deterrance caused by noise. Fish may react to an increased level of noise by leaving the affected region (avoidance reaction) [298, 293, 11]. Avoidance reaction will be stronger in the case of the clupeids and cod, but it will probably affect the flatfish to a lesser extent due to the absence of the swim bladder and the associated low sensitivity to noise impact. An increased concentration of suspended solids may cause a similar avoidance reaction and a periodic reduction in diversity. Similarly, as in the case of noise emissions, the impact effect will be negligible in relation to demersal fish species (the flatfish, common seasnail, gobies). However, in the case of the last two species, their reproduction may be restricted due to demersal spawn being covered by the sediment from the water column. A local decrease in diversity may occur throughout the construction period.

Marine mammals

There are only 3 species of marine mammals occurring more or less sporadically in the Baltic Power OWF Area and adjacent areas. Thanks to the use of NRS, the construction of the Baltic Power OWF will have no impact on this relatively low biodiversity, assuming that no more than 2 simultaneous piling works will be carried out in the Baltic Power OWF Area or in the area of another planned OWF.

Seabirds

The analysis of the possible impacts resulting from the construction activities performed during the OWF construction phase shows that their effects will be temporary and local in most cases. This applies to all types of emissions (noise, suspended solids, release of nutrients from seabed sediments).

As a result of construction works, there may be a temporary change in the species structure in the Baltic Power OWF Area and in its direct vicinity. In the case of seabirds, the most sensitive species will move away from the farm area already during the construction phase, and the number of sea ducks will gradually decrease. An increase in the number of gulls and cormorants is expected, as they use the structures protruding from the water as resting places. Therefore, in the case of birds it cannot be stated that biodiversity will remain unchanged. It should be emphasised that this change concerns the place where the wind farm will be constructed and its nearest vicinity. After the completion of the OWF construction phase and the start-up of wind power stations, some birds representing the species more sensitive to the impact of wind farms (razorbills, sea ducks) may leave the OWF Area and move to the adjacent feeding grounds. The loss of zoobenthos in quantities irrelevant from the perspective of food resources for seabirds will not cause disturbances in food dependencies, which, consequently, will not disturb the existing balance and will not lead to a permanent elimination of species.

The marine habitat will not be fragmented in such a way that the populations related to the Baltic Power OWF Area and adjacent sea areas could be isolated permanently or temporarily.

To sum up, the impact of the project in terms of biodiversity can be considered to be of low importance due to its local range, which is limited to the area occupied by the wind farm together with the surrounding buffer zone with a width of 2−4 km.

6.1.1.5 Impact on cultural amenities, monuments and archaeological sites and objects

The assessment was carried out on the basis of the results of geological examination and geophysical surveys of the seabed in the construction area, which are included in Appendix No to the EIA Report, as well as the results of the project impact.

The assessment covered the probability of occurrence of deposits from the Stone Age in the area of the planned project. The implementation of the Baltic Power OWF project may cause the following types of impacts on hitherto unrecognised objects, which may be uncovered and identified, and which may be important from the point of view of the protection of cultural heritage (archaeological relics dating to the Stone Age):

- damage to or complete destruction of archaeological relics by vessel anchors;
- damage to or complete destruction of archaeological relics during embedding of the GBS and laying of cables;
- damage to archaeological relics during installation of pile foundations;
- soil subsidence;
- exposing archaeological objects;
- sedimentation of disturbed sediment;
- discovery of new objects (positive aspect).

During the construction works, new unidentified archaeological sites, objects or artefacts may be discovered which, due to a lack of knowledge about their existence at this stage, have not been included in the impact assessment presented in this EIA Report.

Based on the analysis conducted, it was found that the significance of the impact caused by the project in question on the prehistoric archaeological relics from the Stone Age will range from insignificant to low.

It was found that all potential impacts of the Baltic Power OWF on potential Stone Age relics will be insignificant, except for the impact related to the embedding of pile foundations, the significance of which was assessed as low. The results of the assessment have shown that the project consisting in the construction of the Baltic Power OWF will not have a significant negative impact on objects of great importance for the protection of cultural heritage in the APV during the construction phase.

Considering the problem of the presence of Stone Age relics (mainly residues of late-Palaeolithic and Mesolithic settlements) in the area of the planned project, it should be taken into account that the relevant area potentially inhabited by Stone Age communities underwent irreversible transformations or destruction due to natural factors. Its identification is not only impossible from the perspective of conventional land archaeology but is also extremely complex from the perspective of underwater archaeology methods.

The scale of paleolandscape transformations from the turn of Pleistocene and Holocene is confirmed by the results of geological surveys carried out in the Baltic Power OWF Area. Their dynamics led to a total erosion of stratification, which may have contained relics of human settlements in this area during that period, namely the Pleistocene and early Holocene. As a consequence, the chance of accidental penetration of Stone Age relics during the construction phase should be considered as close to zero in this area.

Although the current state of knowledge on the history of the Pomerania settlement in the Stone Age does not exclude the possibility of settlement in the late Palaeolithic and Mesolithic periods in the areas overlapping with the project area, the possibilities of observing and identifying its relics in the form of:

- archaeological sites of the Stone Age (the so-called compression wood);
- anthropogenic in-ground objects;
- single stone and organic artifacts;

are far more complex.

Even if the said relics potentially exist as a component of seabed layers in the Baltic Power OWF Area, the possibilities of identifying and tracing them are extremely small. Moreover, the Register of Underwater Archaeological Sites does not contain information on any submarine archaeological sites dating to the Stone Age located in the area of the planned project.

This is due to the strong erosion identified in the areas located so far north of the current shoreline of the Southern Baltic [426] and sedimentation processes which seized paleolandscape relics, which was confirmed by the results of geological and geophysical surveys, included in Appendix 1 to the EIA Report.

In the context of the most important conclusions from the geophysical surveys aimed at identifying anthropogenic relics in the Baltic Power OWF Area, it should be mentioned that:

- explorations using seismo-acoustic and geological methods as well as ROV inspections did not confirm the presence of settlement residues from the Stone Age;
- geophysical surveys carried out to identify the relief and structure of the seabed, as well as the reconstruction of the paleolandscape, did not confirm the occurrence of anthropogenic objects related to prehistoric settlement;
- inspection of geological core samples carried out to detect the presence of archaeological relics (i.e. elements of cultural heritage from prehistoric periods) did not confirm the possibility of finding them within the project area.

Appendix 1 to the EIA Report describes the wrecks found in the OWF Area, amounting to five units. All the wrecks were reported to the relevant authorities. Two of them had been previously found and their positions are recorded in nautical charts. The Applicant assumes preventive limitation of activities related to seabed disturbance (systems, anchoring, foundations) at a distance of up to 100 m from the wrecks reported.

To sum up, at the construction stage, the planned Baltic Power OWF project will not have a negative impact on the potential objects of great importance for the protection of cultural heritage of the Stone Age. The surveys carried out in the area in question did not reveal any archaeological objects or strata related to the settlement in the Stone Age.

6.1.1.6 Impact on the usage and development of the sea area and on material goods

During the construction phase of the Baltic Power OWF, this area will be gradually excluded from shipping, fishing, survey and tourist cruises due to safety reasons. Only the presence of vessels related to the project implementation will be allowed. The construction of the Baltic Power OWF will not disturb the use of the MW P-18 and MW P-19 military training areas. The elements of cultural heritage identified during the surveys should be protected by establishing zones excluded from construction works at a distance of up to 100 m. Increased traffic of vessels serving the construction of the OWF may mean difficulties in the vessel traffic on the route located south of the OWF.

Limitations resulting from the gradual exclusion from the previous use of the Baltic Power OWF Area will have the greatest impact on fishing, including in terms of fishing sites, as well as the necessity to extend the routes to the fisheries located north of the Baltic Power OWF Area. The impact on fishing will be negative (due to restrictions) and direct (directly affecting the receptor). Moreover, due to the assumed duration of the construction phase (from 2 to 8 years), this impact will be long-term and local (limited to the Baltic Power OWF Development Area).

Taking into account the fact that the previous use of the Baltic Power OWF Area for fishing activities was small and that this activity can be carried out in neighbouring sea areas, it should be assumed that the significance of the Baltic Power OWF impact on fishing will be negligible.

6.1.1.7 Impact on landscape, including the cultural landscape

During the construction phase of the planned OWF, the following potential impacts of the project on the landscape, including the cultural landscape, were identified:

- traffic of vessels, mainly the vessels of contractors of the construction works, as well as contractors of surveys, supervision and other works;
- transport of structural components of the OWF, including large-size components;
- successive erection of offshore structures, such as wind power stations, substations, platforms and others.

The impact on the landscape will be objective, changing its character from natural to industrial, but also subjective, depending on individual characteristics of the receptor, and may be perceived as negative, positive and indifferent.

The offshore structures may be constructed one by one, in stages. It is expected that the OWF construction phase may last from 2 to 8 years. The offshore structures will be painted, marked and illuminated at night to ensure maritime and aviation safety.

The impact of the OWF on the landscape during the construction phase depends on:

- the traffic of construction-related vessels, size of structures transported;
- the size of structures, diameter of a rotor and its position in relation to the viewer;
- the number and location of OWPS and facilities;
- meteorological conditions and the sea state;
- location of the landscape observer.

In the OWF Area, people not directly associated with the OWF are present temporarily. These are the workers on board of vessels, passengers of tourist ferries, fishermen and deep-sea anglers, tourists on recreational crafts, participants in search and rescue operations flying over the sea in airplanes, scientists and others. The planned OWF will be most visible to this group but more people will be able to observe the OWF during the day rather than at night when, for example, some of ferry crews and passengers will be asleep. During the construction, this group will be increased by the employees of the OWF construction vessels. The impacts on the landscape will be short-term, temporary, and will depend on how long the observer can see the construction of the OWF, and the transported components.

During the construction phase, the landscape will change not only at sea, but also in ports where offshore structures will be built. The impacts on the landscape in this respect will be short-term, temporary and, above all, they will take place in industrial and port areas, depending on the location of the production area, they will be more or less visible to a third-party observer; these will be medium-size and large ports. The landscape of ports and industrial areas is transformed, there are many facilities and structures changing the landscape to industrialised, anthropogenic; they may partially or even completely obscure the observer's view of the structures constructed for the needs of the OWF.

The impact was assessed as negligible, although it varies depending on the distance of the observer from the OWF and the type of the landscape affected. In the open sea, the landscape is not disturbance-resistant, but its value is not high, as very few people and over a short period will be exposed to the landscape change and some of them (e.g. tourists) may perceive it as advantageous or interesting. The spatial range of the impact will be large, it will decrease as the distance from the OWF increases, the vessel traffic will increase from time to time, and at ports the impact will be local.

6.1.1.8 Impact on population, health and living conditions of people

During the OWF construction, the population will be affected at different levels of intensity in onshore and offshore areas. Basic components of wind power stations will be stored and assembled in harbour and shipyard areas, namely: the foundations or support structures, towers, and nacelles with rotors. In other factories, substations and platforms supporting the infrastructure required for the correct functioning of the OWF will be constructed. They will be produced for several years using various technologies, and then transported by vessels to their location at the OWF. The construction phase of the planned project will result in ensuring work for many people in the shipbuilding, power, power engineering and maritime transport industries. Potentially large plants and ports from the Tricity as well as Świnoujście and Szczecin areas will be involved in the production and transport of wind power station components for the needs of the OWF. Within the boundaries of the plants and port infrastructure located there, OWF structures and equipment will be manufactured; moreover, the components transported from other production plants may be reloaded there. In these centres, impacts on the health and living conditions of the people employed will occur regarding noise emission, air pollution, sewage and waste. Smaller ports, such as Władysławowo, Łeba, Ustka, Darłowo, Kołobrzeg and Dziwnów, if the existing infrastructure is adapted, may also act as service or rapid response ports, with similar impacts on the health and living conditions of the people employed related to noise emission, air pollution, sewage and waste, only on a much smaller scale.

In the offshore areas, the long-term period of the OWF construction will cause significant changes to shipping routes in the vicinity of the OWF and significant disturbances in the navigation of all vessels since the area overlaps with the main navigation routes of the Southern Baltic. It will increase the risk for the safety of navigation of all types of vessels, including recreational crafts, and for the functioning of the fishing industry in this region of the sea. The construction of the offshore farm of this size, such as the Baltic Power OWF, may require more than 4000 passages per year of vessels of various sizes between the OWF, the Bay of Gdańsk and the ports in Łeba and Władysławowo. It will have a significant impact on the safety of navigation. During the construction period, the fishing industry will have to abandon fishing in some of the fishing squares: N7, N8, O7 and O8 in the sea areas covered by construction works.

The on-going exploitation of crude oil and natural gas in B3 and B8 reservoirs and the planned exploitation of B4 and B6 submarine natural gas reservoirs will not be disturbed due to a significant distance of several dozen kilometres, separating the said reservoirs from the Baltic Power OWF Area.

The process of the Baltic Power OWF construction will limit the offshore activities related to crisis management and emergency response. It applies to various types of emergency events and accidents involving vessels, rescue operations, rescuing property or combating oil pollution.

In offshore areas, the potential impact on health conditions and human life will be related to the transport and erection of structures of individual wind power stations and possible collisions of vessels with the OWPS structures.

To sum up, the scale of impact on the population, health and living conditions of people during the construction phase will be ’small‘ and when assessing the significance of the receptor as ’very high‘, it can be assumed that the significance of the impact will be moderate.

6.1.2 Exploitation phase

6.1.2.1 Impact on geological structure, seabed sediments, access to raw materials and deposits

Changes within the seabed associated with the project impact will be local and, within the entire area occupied by the project, insignificant for the overall character of the seabed and its structure.

Depending on its structure, the seabed may exhibit different sensitivity to the impact of the project during its exploitation phase. The seabed made of till and till with a stony cover is difficult to wash out and withstands morphological changes. A sandy, sandy and silty, and silty seabed is more susceptible to washout and material being moved over it, e.g. in the form of sandy waves. Thus, the elements of the OWF infrastructure may be uncovered or buried, both as a result of natural processes involving the movement of rock material along the seabed and as a result of this movement being disrupted by the OWF infrastructure components.

Activities connected with the project exploitation may cause the following types of impact on the seabed:

- local changes in the seabed relief associated with the presence of the OWF infrastructure components and their impact on the processes of sediment transport and deposition: seabed washouts upstream/downstream of the OWF infrastructure components, formation of sediment accumulation upstream/downstream of infrastructure components (sandy drifts), cavities in the seabed created at the anchoring places of the OWF maintenance vessels.

No changes in the seabed structure are expected during the project exploitation phase. The overall impact of the project during the exploitation phase can be assessed as negligible.

6.1.2.2 Impact on seawater dynamics

As part of the assessment of the project impact on sea waters, wave motion and sea currents were analysed. The results of the measurements carried out show that in the Baltic Power OWF Area, the velocities and directions of water flows constantly change. As a result of OWPS construction in this area, these flows may change. This may be influenced by factors such as:

- the number of OWPS, the distance between them and their distribution arrangement;
- dimensions and shape of individual OWPS towers;
- type and dimensions of foundations or support structures;
- flow field characteristics (velocities, prevailing directions, etc.);
- seabed relief with particular consideration of surface gradients and natural obstacles.

As a result, the velocities and directions of water flow and pressure in the direct vicinity of each structure may change, which will manifest itself in a local increase in water flow velocity due to the narrowing of the flow stream and formation of whirlpools around the structure. The whirlpools can be formed both downstream and directly upstream the obstacle. The range of the support structure impact on water flows in the water depth is only equal to several diameters of this structure, i.e. not more than several dozen metres. However, the distances between individual wind power stations will amount to at least 4 rotor diameters, i.e. they will exceed the range of this impact several times. This means that overlapping of these impacts should not be expected and the disturbances will only be local.

The resulting modifications of the wave motion can be noticed only in the close vicinity of individual wind power stations. However, they are of local nature and should not occur outside the Baltic Power OWF Area.

Wind waves on the free sea surface, encountering obstacles in the form of wind power station towers, flow around them, while losing part of their energy. If the diameters of the OWPS towers are smaller than one fifth of the length of the waves propagating in their direction [270], such towers may be treated as streamlined structures. This means that they will not cause a significant disturbance of the wave field. Otherwise, the waves, approaching the structure from the windward side, will be partially refracted, and on the leeward side − diffracted, i.e. subject to symmetrical deflection of the wave radius behind the obstacle encountered. There is no wave motion in the shadow area, i.e. directly behind the obstacle encountered by waves, but water whirlpools may occur in such places. However, upstream the construction, the refracted waves interfere with the incoming waves, as a result of which standing waves are formed. As a consequence, when applying the linear theory for simplification reasons, vertical orbit velocities double immediately upstream the structure. If such waves are long enough to affect the seabed, they may, in connection with the sea currents, contribute to entraining the sediment from the seabed and, consequently, lead to erosion in the immediate vicinity of the foundation or support structure. The resulting disturbances of wave motion can be noticed only in the leeward zone. However, they are of local nature and should not occur outside the Baltic Power OWF Area. The impact of wind power stations on the wave field and sea current field will be local and will not be of primary significance for these elements.

The Baltic Power OWF is located outside the Słupsk Furrow sea area, through which oxidised and more saline waters from the North Sea are transported, and which, after rare, but very important for the Baltic Sea ecosystem inflows, propagate through the Słupsk Furrow to the Gdańsk and Gotland Deeps. The Baltic Power OWF will not affect these processes.

Significance of the Baltic Power OWF impact on the dynamics of sea waters in the APV during the exploitation phase was assessed as negligible.

6.1.2.3 Impact on seawater and seabed sediments quality

During the Baltic Power OWF exploitation, works affecting the quality of water and seabed sediments will be carried out in its area. These will mainly be service works and interventions in case of an emergency situation.

It was found that OWPS, during their exploitation phase, may cause various **types of impacts** on the receptors discussed (water and seabed sediments); these include: the release of pollutants and nutrients from sediments to water, contamination of water and seabed sediments with oil derivatives, contamination of water and seabed sediments with anti-fouling agents, contamination of water and seabed sediments with accidentally released municipal waste or domestic sewage, contamination of water and seabed sediments with accidentally released chemicals and waste from exploitation and maintenance of the OWF, contamination of water and seabed sediments with compounds from anti-corrosion agents and the change of seabed sediments and water through the reception of heat from transmission cables.

Release of pollutants and nutrients from sediments into water

During the Baltic Power OWF exploitation, works causing the disturbance of seabed sediments, e.g. maintenance of foundations, cables or anchoring of vessels, will be carried out. They will boost the transfer of pollutants and nutrients from sediments to water.

Labile metal complexes, organic pollutants, i.e. PAHs and PCBs, nutrients (nitrogen and phosphorus) may enter the water.

Since the seabed sediment in the area surveyed is characterised by low content of harmful substances (metals, PAH, PCB, TBT) and nutrients, the risk of their transfer to water is low (will slightly deteriorate the water quality). Sensitivity of water and seabed sediments to the above impact was assessed as negligible.

The release of pollutants and nutrients from seabed sediments during the exploitation phase is a direct negative impact which is local, short-term, reversible, repeatable during the exploitation period, and of low or medium intensity.

The significance of this impact during the exploitation phase in the APV was assessed to be of low importance for sea waters and as negligible for seabed sediments.

Contamination of water and seabed sediments with oil derivatives during normal operation **of vessels during routine maintenance activities and during breakdowns or collisions.**

During normal operation of vessels when carrying out service works on power stations, leakages of various types of oil derivatives (lubricating and diesel oils, petrol) may take place.

These may contribute slightly to the deterioration of water quality. Heavier oil fractions may undergo sorption on the surface of organic and mineral suspended solids, which will increase their specific gravity and make them gradually sink to the bottom. There, they may also be bound within seabed sediments.

During the maintenance of the wind farm components, leakages of various types of oil derivatives may occur while they are being replaced during the service works on wind power stations and substations. Transformers should be equipped with devices minimising such risk, with tight oil pans and the rainwater drainage system should be equipped with an oil derivatives separator [395]. If such solutions are applied, no significant spills outside the facility are expected.

Contamination of sea waters or seabed sediments with oil derivatives released during normal operation of vessels in the OWF exploitation period is a direct negative impact which is local, temporary or short-term, reversible, repeatable, and of low intensity.

The significance of this impact during the exploitation phase in the APV was assessed as negligible for sea waters and seabed sediments, whereas in case of a breakdown or collision, it was assessed to be moderate.

Accidental contamination of water and seabed sediments with anti-fouling agents containing TBT

Contamination of water or seabed sediments with anti-fouling substances during the exploitation phase is a direct, negative impact of local range, which is short-term, reversible, repeatable during the exploitation period, and of low intensity.

The significance of this impact during the exploitation phase in the APV was assessed as negligible for sea waters and seabed sediments.

Contamination of water and seabed sediments by accidental release of municipal waste or domestic sewage

The sensitivity of both receptors is negligible.

Contamination of water or seabed sediments with municipal waste or domestic sewage is a direct, negative impact of local range, which is short-term or momentary, reversible, repeatable during the exploitation period, and of low intensity.

The significance of this impact during the construction phase in the APV was assessed as negligible for sea waters and seabed sediments.

Contamination of water and seabed sediments with accidentally released chemicals and waste from the OWF exploitation

During the OWF exploitation, the maintenance of its facilities will be carried out. The possibility of small quantities of waste or operating fluids being accidentally released into the sea cannot be excluded.

The waste most frequently generated in this phase of the project is waste from groups 13, 15, 16 and 17 of the Annex to the Regulation of the Minister of Climate of 2 January 2020 on waste catalogue (Journal of Laws of 2020, item 10) [395]. Thus, it is necessary to comply with the procedures concerning waste handling.

The sensitivity of both receptors in the case of this impact is moderate.

Contamination of water or seabed sediments related to the process of the OWF exploitation is a direct, negative impact of local range, which is short-term or momentary, non-reversible, repeatable during the exploitation period, and of low intensity.

The significance of this impact during the exploitation phase in the APV was assessed as negligible for sea waters or seabed sediments.

Contamination of water and seabed sediments with compounds from anti-corrosion agents

Steel elements of foundations or support structures of the wind power station and substations will corrode in the marine environment. Thus, it will be necessary to apply appropriate safeguarding measures.

The most common anti-corrosion protection method used in the marine environment is cathodic protection. It can be implemented as a galvanic or electrolytic protection.

Galvanic cathodic protection consists in the installation of aluminium or zinc anodes on foundations or support structures. The anodes are gradually worn out and the aluminium or zinc are transferred to water and accumulate in the seabed sediments.

Zinc is the most commonly used steel protector against seawater. Its current efficiency reaches 90% at a relatively low production cost. The disadvantage of zinc is a small potential difference compared to steel, amounting to approx. 0.25 V. Zinc is used as pure metal (99.99%, with a limited pollutant content of Fe, Cu and Pb) or as a metallic matrix containing: Zn+ 0.1–0.15% Hg, Zn + 0.12–0.18% Al + 0.05–0.1% Cd, Zn + ca. 0.5% Al + ca. 0.1% Si [397].

Aluminium is used only in the form of alloys: with zinc (3–6% Zn), with tin (0.1–1% Sn), with Zn + In, Zn + Hg, Zn + Sn. The current efficiency of these alloys is high, in the order of 80%. Aluminium alloys are used in the same manner as zinc. They belong, next to zinc and its alloys, to the low-potential protectors [397].

The advantages of the galvanic cathodic method are the independence from current sources, ease of installation, possibility of local protection and low impact on neighbouring structures. However, the most important disadvantages include: the irreversible loss of anode material, the possibility of contamination of the environment with corrosion products of the protector, the limited use due to the environmental resistance and the low protective current.

In the initial period of exploitation, the emission of zinc and aluminium from anodes will not be observed. This process will take place over time and will progress with the increasing degree of damage to the protective coating on the components subject to corrosion protection. It is assumed that the entire anodes dissolve during the period of approx. 20 years. The metals in question will first be transferred to water in which they can undergo precipitation and accumulate in the sediment. This applies in particular to aluminium compounds, as its solubility in natural waters (with pH of approx. 8) is very small. It will be largely adsorbed by seabed sediments in the form of stable compounds. Zinc compounds may be present in water longer than aluminium, as most of them are soluble in water. Zinc will be adsorbed and co-precipitated with hydrated Fe, Mn and Al oxides, present in sediments, however, this process will take place slowly due to the low content of silty minerals in the Baltic Power OWF Area, which favour zinc adsorption [8, 357].

Ecotoxicity tests have shown a significant toxicity of aluminium to aquatic organisms such as algae, fish and first-order consumers [220, 289]. Excess aluminium causes decalcification and deformation of bones as well as anaemia and hardening of cellular membranes [289]. Harmful effects on fish are probably associated with the process of precipitation of this metal on gills as a result of defensive mechanisms (e.g. release of neutralising compounds Al^{+3}) [206]. The biological role of aluminium for humans has not yet been fully clarified, but it is suspected that it may cause Alzheimer's disease. Aluminium accumulates in the brain [117, 289].

Zinc is one of the more mobile metals in sediments, influenced by its replaceable forms as well as its binding with organic substances [206]. It regulates the metabolism of carbohydrates and proteins in plants. Its excess (100−400 $mg \cdot kg^{-1}$ depending on the species) causes the development of chlorosis and necrosis. This phenomenon is related to iron shortage and photosynthesis inhibition. In vertebrate organisms, zinc also contributes to the metabolism of proteins and carbohydrates, to the detoxification of heavy metals in cells and to the increases in the activity of enzymes and hormones. Zinc also has a positive effect on brain activity, tissue regeneration and wound healing. In the case of acute zinc poisoning, there may be a shortage of copper in blood, hypocalcaemia, pancreatic inflammation, vomiting, diarrhoea and kidney damage [289].

In the electrolytic cathodic protection, the protected object becomes a cathode of an electrolytic cell supplied with direct current from an external source. The anode used in this circuit is most often insoluble. The most persistent anode materials used in this method are platinum and titanium electrodes covered with a 2−3 µm platinum layer. When electrolytic cathodic protection is used, no impact on the quality of water and sediments is observed.

If electrolytic cathodic protection is used, metal (Al, Zn) releases to the water environment will not be observed due to the use of insoluble anodes. This impact was not assessed.

The most important parameters affecting the impact level are the type and quantity of elements released, water quality in the project area and the type of rock material forming the seabed.

The sensitivity of both receptors in the case of this impact is moderate.

Contamination of the environment with aluminium or zinc released during exploitation with the use of galvanic cathodic protection is a direct, negative impact of local range, which is long-term, irreversible, permanent, and of medium intensity.

The significance of this impact during the exploitation phase in the APV was assessed as negligible for sea waters and seabed sediments.

Change of water and sediment temperature through heat reception from transmission cables

The electric current flowing through a power cable causes its heating related to power losses due to resistance, in accordance with Joule's law. As the cable temperature rises above the ambient temperature, heat is released into the environment surrounding the cable.

A precise quantification of the dissipated heat is difficult because of the phenomena such as conductivity, convection and heat radiation, subject to various physical laws [391].

Increasing the temperature of sediments in which the cable is buried and the interstitial waters (water filling the spaces between sand grains in the sediment) may cause:

- increased bacterial activity resulting in accelerated distribution of organic matter;
- decrease of oxygen content in water;
- release of harmful substances, including metals, from sediment into water;
- adverse effects on benthic organisms.

The most important parameters affecting the impact level are the depth of cable burying and the type of seabed.

For example, in the operating Nysted Offshore Wind Farm, the temperature increase emitted by the transmission cable (132 kV) buried at a depth of 1 m did not exceed 1.4 °C in a layer of 20 cm above the cable, and the temperature changes were already invisible on the seabed surface [285]. This cable was buried in gravel sediment, which favours much higher heat loss in interstitial spaces between sediment grains than in the case of fine-grained sediment [285]. Both types of sediment are common in the Baltic Power OWF Area. It should be assumed that the heat dissipation ($24 \cdot h^{-1} \cdot m^{-1}$ on the cable surface) emitted by inner-array 33 or 66 kV cables belonging to the Baltic Power OWF will be smaller than (or, at most, similar to) that recorded in the Nysted OWF.

The heat emission above the Baltic Power OWF cables in the sediment will be local and the effect will be imperceptible if the cable is buried deeper than 1 m, which is compliant with the technical assumptions of the project for the inner-array power cables which are to be buried at a depth of up to 3 m.

Heat emission from cables is a direct, negative impact of local range which is long-term, irreversible, permanent during the exploitation period, and of medium intensity.

The significance of this impact during the exploitation phase in the APV was assessed as negligible for sea waters and seabed sediments.

6.1.2.4 Impact on climate, including greenhouse gas emissions and impacts relevant in terms of climate change adaptation and impact on the air (state of the air)

The wind power stations will locally reduce wind energy and disturb atmospheric pressure directly in the area of the rotor operation. The wind power station towers may locally disturb the velocities and directions of water flows and reduce the energy of sea waves, which is reflected in their height drop.

Due to the significant distance of the Baltic Power OWF Area from the coast and from other potential sources of pollutants emission, it should be assumed that the air quality within this area will correspond to quality class A. Due to the fact that the emissions generated during the OWF exploitation will be minimal (coming mainly from Diesel emergency generators installed in substations, if installed, and air conditioning equipment as well as, to a small extent, from service vessels), it is practically possible to assume no emission of particulate pollutants and only a slight emission of gaseous pollutants, including carbon dioxide which is a greenhouse gas. Therefore, it is not expected that air quality will deteriorate, and its quality class will be lowered.

During the exploitation phase, the planned project will have both negative and positive impacts on the climate. Negative impacts involve the greenhouse gas emission caused by fuel combustion by service vessels. The positive impact on the climate will be the generation of electricity by the Baltic Power OWF from a renewable source at the level of 1200 MW, which in the case of carbon dioxide emission of the conventional old-type electricity generation at the level of 900−960 kg of CO_2 per 1 MWh will enable a noticeable reduction of gas emissions in Poland.

According to the findings of the GP WIND project [161], the production of electricity from OWPS is associated with the emission of 6 to 34 kg of CO_2 per 1 MWh in all phases of the OWF existence, which, with the expected production of 134.03 TWh during 25 years of exploitation, means the emission of 0.8 to 4.6 million Mg of CO_2. The larger of the quoted values refers to the case when a GBS with the high proportion of cement is used. Even in this case, the emissions will be at least 10 times lower than from the energy generation from other sources e.g. fired with hard or brown coal (emission reduction of over 48 million Mg of CO_2 are expected – without taking into account the emissions related to the construction of these sources).

During the exploitation phase, local greenhouse gas emissions will slightly increase as a result of fuel combustion by service vessels carrying out maintenance activities for the wind farm, but their impact will be compensated by the reduction of emissions in the generation of wind energy.

Climatic conditions of the Southern Baltic area related to the formation of weather phenomena (mainly temperature, precipitation and wind) are subject to continuous changes over a multiannual period, which, although related to global climate changes, are generally of a regional character. Due to the fact that the expected range and scale of these changes in the period of several dozen years for which the exploitation of the Baltic Power OWF is planned is relatively small, the forecast climate changes in the Baltic Sea area will have little impact on the planned OWF Area and a small impact on the operating conditions and safety of wind power stations. However, it should be noted that in order to ensure proper operation of the wind farm, it is necessary to take into account the possibility of extreme weather conditions at a scale greater than currently observed, as well as the fact, that the range of their variability throughout the year and in individual years will increase, taking into account the expected tendencies of changes over several dozen years.

The increase in intensity and frequency of storm phenomena observed at sea should cause some increase in the productivity of the Baltic Power OWF. However, on the other hand, it may result in a higher breakdown rate of OWPS and a periodical deterioration of navigation conditions in the OWF Area. Therefore, the risk of more frequent occurrence of winds above Beaufort force 10 than in the current conditions should be foreseen. A possible increase of the mean sea level as well as changes in the thermal conditions and salinity of water will have no noticeable impact on the exploitation, operating conditions and safety of the Baltic Power OWF equipment. The forecast increase of sea surface temperature will practically exclude the risks related to icing phenomena. However, the forecast increase in the amount of precipitation and humidity of the lower atmosphere layer will increase the risk of wind power stations being iced (in the case of negative air temperatures, in this respect, however, it is expected that the number of frosty and very frosty days will decrease) as well as the frequency of periods of limited visibility.

For open sea areas, the shortening and easing of ice periods will have a beneficial impact on shipping conditions and the exploitation of the equipment at sea.

Progressing eutrophication of sea waters may cause some difficulties in the exploitation of the planned OWF, especially in the summer period. Temperature increase in the winter period may cause the disappearance of species typical for cold water and the occurrence of species present in warmer waters.

During the exploitation phase, the direct and local impact of the planned project (related to the use of vessels and fuel consumption by them) will not have a significant impact on the change of climatic conditions. Despite the impact being long-term, its range will be local. However, indirectly, the exploitation of the wind farm will result in the reduction of greenhouse gas emissions to the atmosphere by other sources, e.g. coal-fired power plants located in other areas of the country. Therefore, despite the significant importance of the climate and air quality and the small scale of the Baltic Power OWF impact in the Applicant Proposed Variant during the exploitation phase, it may be concluded that the impact in terms of greenhouse gas emissions from vessels to the atmosphere will be negligible. The impact of the reduction of greenhouse gas emissions is positive but difficult to estimate. This is due to the fact that the emission reduction will be assigned to a completely different area (the location of an equivalent conventional, fossil fuel fired power plant).

6.1.2.5 Impact on systems using EMF

It follows from the exploitation of offshore wind farms so far that the operation of wind power stations and certain types of tower structures may adversely affect the operation of offshore and onshore navigation support devices or other applications. This applies in particular to radars, communication systems and radiolocation devices, such as AIS, which are on board of any vessel with a gross tonnage of more than 300 Mg.

British experience shows that OWFs may, in exceptional situations:

- disrupt the operation of the ship radar;
- reduce the effectiveness of the radar operation;
- affect radio communication;
- cause interference of waves emitted from vessels, coastal systems and OWF equipment;
- reflect and deform signals through the structures of towers and the OWPS blades.

The systems the operation of which may be disturbed by the Baltic Power OWF include:

- the components of the National Maritime Security System (NMSS) such as coastal radar systems, AIS signal recording stations, radio communication;
- emergency communication system of the Global Maritime Distress and Safety System (GMDSS);
- SAR communication systems;
- Border Guard and Polish Navy systems such as communication and radar systems;
- navigation systems on vessels shipping near the Baltic Power OWF such as radio communication, radar navigation systems and AIS transmitters/receivers;
- radio and TV signal.

The impact on radar systems is shown on the example of the Triton Knoll OWF. For the purpose of assessing the impact of the Triton Knoll OWF (United Kingdom) on navigation radars and other navigation support facilities (navigation buoys, RACON marking), QinetiQ carried out surveys in 2010 [459]. The following scenario of activities in the OWF area was adopted:

- 240 wind power stations with a power output of 8 MW (maximum number and capacity of the wind power stations);
- a number of vessels (commercial vessels with a length of 100 m and fishing vessels with a length of 20 m);
- navigation radars operating in the X and S bands.

The study examined the impact of the presence of wind power stations on the capability of the radars to detect different objects (vessels, drilling rigs, navigation buoys) for different locations of these radars, as well as the possibility of using the "Sensitivity Time Control" (STC) – a tool enabling radar control and improving image visibility.

For each location, radar capability to detect target was analysed in the following aspects:

- probability of target detection;
- image saturation;
- physical shadow effect;
- detection capability in the area of radar antenna lobes;
- false images and areas of false images.

Probability of object detection

The study assumes that the objects assumed in the maximum scenario should be detected by radars operating in the X and S bands, regardless of the type of vessel on which they are located. The 90 m long blade should be detected at a distance of 35 NM (64.8 km) and the nacelle located at a height of 130 m should be visible at a distance of 25 NM (46.3 km). This means that the target covering both the wind power station towers and the rotor blades appears as separate one if the radar operating range is less than 24 NM (44.4 km). It should be assumed that a clear image of objects detected on the increased range of radars will provide additional navigation support in addition to the existing marking.

The use of STC can reduce the signal strength (reception) as a function of the range. STC reduces X-band and S-band reception to the following extent:

- for commercial vessels:
  - range of 0 NM – maximum reduction,
  - range of 11 NM – minimum reduction;
- for fishing vessels:
  - range of 0 NM – maximum reduction,
  - range of 4 NM – minimum reduction.

Image saturation

The radar signal received when the dynamic radar range is exceeded causes the image to be oversaturated and blurred. The study demonstrated that for commercial vessels such effect may occur at a distance of 1.3 NM (2.4 km) from wind power stations for S-band radars and at a distance of 1 NM (1.8 km) from wind power stations for X-band radars. X-band radars operating on fishing vessels may be disturbed at a distance of less than 0.5 NM (0.9 km). At the same time, it was found that the effects of image oversaturation were completely eliminated through the use of STC.

Physical shadow effect

The potential shadow effect is the most serious phenomenon for navigation. For large facilities, such as OWF structures, the effect increases as these facilities are approached. In this case, the interference depends on the effective radar cross section (RCS) area, the shadow depth and the signal strength.

The study showed that S-band radars can be disturbed (shadow effect becomes dominant) at a distance of 5 NM (9.3 km) and create a 200 m wide shaded sector. X-band radars operate much better under the same conditions – the width of the shaded sector is approx. 100 m. In the case of the scenario assumed for the Triton Knoll OWF (240 wind power stations), the level of interference may result in the reduction of the detection capability by approx. 29%. It should be expected that for the Baltic Power OWF the said level will be lower.

The shadow effect may be additionally reduced by the application of corrective measures – radar stations located near the OWF. Selection and operating parameters of the equipment will depend on the technical specification of the OWF and other projects located in the vicinity. The application of mitigation measures may concern, in particular, systems using coastal stations for their operation (e.g. radar systems related to state defence).

Radar wave interference from antenna lobes

Apart from the main narrow radar waveform generated by the antenna, there are many side streams (lobes) which create unwanted (false) images. The presence of a wind power station at a distance of less than 0.5 NM from a commercial vessel results in a decrease in the probability of detection in an area with an angle of about 100°, but the use of STC eliminates these disturbances, reducing this angle to about 10°.

False images

The presence of many facilities with high reflectivity, concentrated at a short distance from each other, may cause false images on radar screens. Therefore, OWF power stations may contribute to the occurrence of this phenomenon. This applies, in particular, to the situation in which the facility located in the OWF area is to be detected. In the case of facilities located outside the OWF Area, this phenomenon is much less important.

Additional reflections of images of vessels located there may occur in the immediate vicinity of the OWF. Occurrence of this phenomenon depends on the radar type and the mutual position of the facility in which the radar is located and the facility to be detected, the possible false image of which may be generated. Generally, the effects of additional reflection and false image generation for the radars operating in the S band will occur in a situation when the radar antenna is located at a distance of 0.5 NM, and the object to be detected is located on the opposite side of the OWF at a distance of 10−15 NM.

The use of STC significantly reduces this type of interference. However, the effects of false images generation should be examined in relation to specific technical solutions for the OWF and the mutual location of navigation routes.

Radio communication and AIS interference

In terms of radio communication and communication in the AIS system, the basic phenomenon affecting the level of communication quality is the physical obscuration of radio signal transmission routes by the OWF facilities. It follows that the significance of these disturbances is significant when the receivers and transmitters (regardless of whether they are mobile or stationary) are located on the opposite sides of the OWF or there are OWF structures between them.

This may, for example, concern the communication of vessels sailing north of the OWF and the coastal AIS stations. In the case of a stationary coastal station and a vessel sailing along the Baltic Power OWF north of it, temporary loss of communication or deterioration of the quality of such communication may take place.

In accordance with the conditions included in the PSzW No. MFW/6/12, as amended, the Applicant shall, at the stage of the preparation of the construction design, provide appropriate expert opinions and make arrangements with the relevant users (Border Guard, Ministry of National Defence, and maritime administration) to implement countermeasures required for accepting the impact of the Baltic Power OWF on communication and radio location systems by them. Therefore, despite the importance of these systems for society and state interest, it should be assumed that the significance of the impact of Baltic Power OWF on these systems will be negligible. In order to meet the above requirements, it may be expected that remedial actions will be necessary, such as an installation of communication and radar systems on the northern edge of the Baltic Power OWF, supporting the operation of especially those maritime administration, Border Guard and Polish Navy systems, which are based on the coastal station systems. The equipment installed shall be connected in real time with the relevant services by means of dedicated data communication links. The determination of specific solutions will be possible only at the building permit stage, when the parameters of the wind power stations (shape of blades, towers and nacelles of wind power stations and also their number and arrangement) are known.

6.1.2.6 Impact on nature and protected areas

6.1.2.6.1 Impact on biotic elements in the marine area

6.1.2.6.1.1 Phytobenthos

During the exploitation phase, support structures of wind power stations and the accompanying infrastructure located under the water surface in the euphotic zone may be overgrown by macroalgae (e.g. [37, 38, 185, 224, 250, 303, 325, 471, 454, 214, 55, 356]). Despite the fact that phytobenthos does not occur in the area of the planned OWF, macroalgae spores may appear in this area due to various natural and anthropogenic factors. The first group should include the transport of spores with the sea currents from the areas of macroalgae occurrence [304, 431, 149, 61]. Macroalgae or their fragments brought with currents from their natural occurrence areas, separated from the substrate by, e.g. storms may also be the source of spores [304, 150]. The anthropogenic factors include mainly the transport of spores in ballast waters of vessels [137, 255], e.g. vessels involved in the construction and maintenance of the wind farm infrastructure. They can also originate from the macroalgae growing on the hull of vessels [248, 304]. To sum up, it is likely that the macroalgae spores are present in the maritime area of the OWF and once a hard substrate appears in the euphotic zone, they will find favourable conditions for the development and will begin the colonisation process. This process is likely to begin already in the first vegetation season after the OWF structure is erected. The data from literature indicate that in the initial phase of colonisation, macroalgae with thread-like structured thallus appear first, then are displaced by species with dense thallus [250]. At this stage, it is not possible to determine which species of macroalgae will inhabit the OWF structures, however, some preconditions may result from the surveys performed for the Utgrunden 1 OWF located in the southern part of the Kalmar Strait [62]. In 2007, i.e. 7 years after the commencement of exploitation of the OWF in question the presence of filamentous green algae (*Cladophora* sp.) and red algae (*Ceramium tenuicorne*, *Polysiphonia fucoides* and *Rhodocorton purpureum*) was found on the support structures of wind power stations. The example of *C. tenuicorne* indicates that among the macroalgae growing on structures, there may also be species subject to strict protection under the Regulation of the Minister of the Environment of 9 October 2014 on the protection of plant species (Journal of Laws of 2014, item 1409).

Macroalgae and animal organisms (e.g. mussels) overgrowing the OWF components will create the "artificial reef", a factor causing local increase in biodiversity of plant and animal species *per se* and indirectly affecting the increase in the species richness and quantitative resources of the marine fauna – mainly fish and nekton crustaceans, which will search for food and places convenient for refuge and reproduction within it [9, 10, 458, 457, 454, 258]. Therefore, the effect of the submerged OWF structures being overgrown by macroalgae should be considered as positive, however it should also be noted that the natural character of the maritime area will be disturbed. Locally and in the long term, the functioning of the marine ecosystem will be changed, for which the anthropogenic factor will be responsible.

In conclusion, the significance of the impact was considered positive and negligible.

6.1.2.6.1.2 Macrozoobenthos

The exploitation of the Baltic Power OWF will result in the following impacts:

- the loss of a fragment of macrozoobenthos habitat;
- an "artificial reef" effect.

The assessment of the impact of wind power stations in the OWF Area (1 NM) at the exploitation stage was carried out separately for:

- soft bottom macrozoobenthos;
- hard bottom macrozoobenthos.

These two complexes of benthic fauna differ in taxonomic composition, abundance and biomass of their constituent species. Therefore, they differ in sensitivity and importance of the group of organisms evaluated. The sensitivity of zoobenthos depends on the type of impact and the preferences resulting from the very biology of the species concerned. On the one hand, it is the ability of the population to adapt to various changes occurring in the environment as a result of the project implementation and, on the other hand, the ability of a complex of organisms to reconstruct the quantitative structure after the impact factor ceases to exist. The soft bottom macrozoobenthos complex is of low importance and the hard bottom macrozoobenthos complex is of moderate importance.

The main impact during this phase of the project implementation is **the loss of a fragment of** macrozoobenthos habitat [224, 471]. The seabed development will eliminate biological life from the sediment surface area, in the worst case scenario it will be occupied by the GBS with the largest base diameter from among the types of support structures proposed, together with a protective layer against washout. Estimated calculations indicating the amount of the lost macrozoobenthos resources in the Development Area are presented below.

In accordance with the technical concept in the APV, a permanent loss of habitats with macrozoobenthos complexes under 126 GBSs will occur on the surface of 0.3 km^2, which constitutes 0.26% of the Development Area with the surface of 113.72 km^2. In this study it has been assumed that the hard bottom covers up to 5% of the OWF Area, so taking into account also the assumption that the foundations or support structures of the wind power stations will be evenly distributed (112 foundations or support structures on the soft bottom and 14 on the hard bottom), the loss of soft bottom macrozoobenthos habitat will cover 0.27 km^2 (0.24% of the Development Area) and the loss of hard bottom macrozoobenthos habitat – only 0.03 km^2 (0.03% of the Development Area).

The loss of a part of the habitat is a negative impact occurring during the exploitation phase. The sensitivity of the soft bottom macrozoobenthos and hard bottom macrozoobenthos to this impact is very high, as a part of the benthos complex will be permanently destroyed due to the impact of stress factor present throughout the entire exploitation phase.

Given the moderate scale of the impact on the soft bottom macrozoobenthos, the significance of this impact will be low.

When assessing the impact on the hard bottom macrozoobenthos complex, which is a resource of moderate importance, it should be taken into account that an important component of the food supply of fish and seabirds will be eliminated from the environment. Permanent destruction of the bay mussel aggregation (*Mytilus* sp.) may occur only on the surface of 0.03 km^2, however, the protected long-tailed duck will be deprived of food with a biomass of approximately 72 000 kg, with an average biomass of the hard bottom macrozoobenthos of approximately 2400 $g \cdot m^{-2}$, with the bay mussel (*Mytilus* sp.) having more than 99% share in this complex. Taking into account this fact and the high capacity for recovery of the hard bottom macrozoobenthos resources, this impact was assessed as insignificant.

Once the support structures are introduced into the environment, taking into account the high reproductive potential of macrozoobenthos, the colonisation of artificial hard substrates by animal and plant periphyton complexes, as well as mobile epifauna – the so-called **artificial reef effect**, should be expected there. Although this impact is extensively documented in literature [e.g. 37, 250, 35, 454, 214, 55, 356, 200, 452] there are no studies from the waters of the PMA of the Southern Baltic, where no OWF has been constructed so far and it was not possible to monitor the “artificial reef” phenomenon, and where only experimental surveys were carried out on the structure artificially introduced into the environment [452].

On the basis of literature, it is known that in the place where the hard substrate has not occurred so far, the qualitative and quantitative structure of the macrozoobenthos community will be altered. The process of overgrowing support structures with periphyton organisms (invertebrates and macroalgae) begins after the reproduction of periphyton species and the settlement of larvae on the hard surface of the structure, most often in late spring. Periphyton communities have a significant impact on the marine environment at the ecosystem level, although it is difficult to clearly determine the nature of this impact. On the one hand, this is a positive phenomenon, since there will be an increase in local biodiversity both in terms of species and habitat diversity, an increase in biological production and a change in natural values of this micro-habitat. A new place of refuge for the fry and an attractive feeding ground and spawning ground for many fish species will appear, while the bay mussel (*Mytilus* sp.) aggregations, quickly colonising the hard substrate and usually dominating on support structures, will constitute a new food supply for fish and seabirds, also acting as biofilters, especially in polluted and eutrophic waters [441, 244]. On the other hand, the “artificial reef” effect can be considered a negative impact, as the original character of the seabed habitat fragment will be lost. The artificial environment of underwater, hard structures, as a new micro-habitat, which was created in place of naturally occurring sandy seabed habitats, favours the possibility of foreign and invasive species expansion. In the PMA, non-indigenous species belong to the following groups: phytoplankton, zooplankton, macrophytes, zoobenthos, avifauna and ichthyofauna. On the basis of the surveys carried out as part of an update of the preliminary assessment of the marine water environment status, in 2011−2016, 5 new, introduced foreign species were identified, and all of them were the representatives of macrozoobenthos. Foreign species quickly displace indigenous species, leading to changes in the existing balance in the trophic network [239]. Another negative effect of the artificial reef may be the changes in the resources and structure of zooplankton filtered by periphyton organisms [452], as well as an increase in the biomass of the gelatinous zooplankton (medusae), whose polyps (settled stage) attach to the hard surfaces of the structure [200].

An unambiguous scenario of colonisation of artificial substrates during the exploitation phase in the OWF Area is difficult to predict. It is assumed that first barnacles (*Amphibalanus improvisus*) and mussels (*Mytilus* sp.) will appear, followed by mobile crustaceans (including *Gammarus* spp., *Corophium volutator* and *Monoporeia affinis*) as well as macroalgae. The “artificial reef” will partially compensate for the destroyed macrozoobenthos complex occurring there before the human interference in the environment. However, during the exploitation phase, the conduct of monitoring will be necessary to provide further specificity of the “artificial reef” effect.

In the case of this impact, an assessment of its influence on the natural environment was carried out. The “artificial reef” effect is a long-term and permanent phenomenon, but due to its local range, the impact was considered moderate.

6.1.2.6.1.3 Ichthyofauna

During the Baltic Power OWF exploitation phase, the impacts on ichthyofauna will result from:

- emission of noise and vibration;
- habitat changes;
- creation of a barrier;
- EMF emissions.

Emission of noise and vibration

The impact of noise at the OWF exploitation stage should be much lower than the one observed during construction and decommissioning. It will depend on the environmental conditions (depth, type of sediment, seabed morphology), the type and size of the wind power stations and the wind speed. According to Thomsen *et al.* [417], the sound generated by operating wind power stations will be audible to the salmon and common dab at a distance of approx. 1 km, and 4−5 km for the cod and herring. The maximum range of the masking reaction (interference with sound perception) should be close to the range of audibility. However, for the herring, it is likely to be much smaller [417].

Very few data relate to possible avoidance and behavioural changes caused by noise generated by operating wind power stations. Observations carried out in the area of one of the Swedish wind farms showed no changes in behaviour of eels swimming at a distance of 500 m from the operating wind power station. Comparison of shrimp and cod catches in the vicinity of the non-operating wind power station showed a significantly larger accumulation of fish in the immediate vicinity of the structure (100 m) than at a distance of 800−1000 m, which can be attributed to the artificial reef effect. However, in the case of an operating wind power station, the catch volume decreased double within the 100 m zone. This result can be interpreted as the effect of the noise emitted, but other causes cannot be excluded [448, 447, 417]. According to Wahlberg and Westerberg [442], the avoidance effect can be expected at a distance of only a few metres from the wind power stations.

During the exploitation of the wind farm, ongoing and unforeseen operational and repair works will be carried out. This will involve a periodically increased vessel traffic. This impact may result in both the avoidance response and the TTS. According to the report of the International Council for the Exploration of the Sea [193] on the impact of sound emitted by research vessels, the avoidance reaction may occur when the noise level exceeds the audibility threshold of a given species by 30 dB and the impact range reaches usually 100−200 m. Typical reactions include “diving” or change of movement direction [97]. The experimental studies also found TTS in freshwater fathead minnow exposed to sound emitted by a boat outboard engine [368]. However, according to Thomsen *et al.* [417], there are no scientific grounds for determining the universal noise level of vessels that would not be detrimental to fish.

Fish are capable of acclimatising to changing environmental conditions. During the experiments carried out on the sole and cod, it was observed that during the first sound exposure tests the fish flow rate was much faster than during the subsequent tests. This effect is most likely the result of fish accustomedness to noise [293]. However, in the case of sounds produced by fish used for communication, one way to adapt them is to temporarily modify them. Usually, the length, amplitude or frequency of sound changes [338]. Besides, adult individuals are able to actively avoid the effects of hazardous factors.

The OWF Area is neither a spawning ground for the cod nor for the deep-water spawning European flounder dominant in this area. During ichthyofauna surveys the sprat spawning was found, but this sea area is small in comparison with the large areas of the spawning grounds of pelagic fish. Herring spawning may occur in the OWF Area, but it can be assumed that any disturbances in the reproductive process will not affect the recruitment of this species at the population level.

Emission of noise and vibrations generated during the OWF exploitation may directly affect the ichthyofauna. The above impacts will be of negative, direct, local, long-term and permanent nature.

The sensitivity to the impact for the cod, sprat and herring was assessed to be high and for the European flounder, sand goby and as moderate for the common seasnail.

The significance of the impact was assessed to be negligible for all the fish species examined.

Habitat change

The presence of structural elements of wind power stations involves the creation of additional hard substrates forming a new habitat. Such artificial structures constitute the so-called artificial reef – a new habitat that may be inhabited by periphyton organisms and, at the next stage, also by other organisms (including different developmental stages of fish). The scale of this phenomenon depends both on the reef size and the complexity of its structure, as well as the environmental conditions in which it was created and the composition of ichthyofauna in its area [167]. At the project design stage, it is possible to increase this effect by using materials and structural solutions expanding the structure surface available to organisms, e.g. structures protecting the seabed around foundations or structures protecting against erosion [243].

At the first stage, the reef becomes inhabited by periphyton organisms, macrophytes and invertebrates [131]. Already several months later, numerous populations of fish [423, 392, 48] appear in the reef area, both those returning after the cessation of the disturbances related to the construction [344] as well as those not present in this area so far (increase in biodiversity). According to Bohnsack and Sutherland [47], the process of creating a stable artificial reef system usually takes 1 to 5 years.

Artificial reef is an attractive habitat that can offer rich food resources, shelter and create favourable conditions for reproduction for many fish species, for adult stages as well as eggs, larvae and juvenile individuals. Extensive hard structures (e.g. submerged structural elements of a wind power station) are attractive shelters for young (2−3 years) cod [347]. They are sheltered from sea currents, predators [47, 455] and fishing pressure. Artificial reefs may also provide favourable breeding conditions for many fish such as the herring (*Clupea harengus*), hooknose (*Agonus cataphractus*), garfish (*Belone*

belone), lumpfish (*Cyclopterus lumpus*) and the rock gunnel (*Pholis gunnellus*) [471]. According to Spanggaard [384], the artificial reef area also provides preferable spawning conditions for gobies, which include species protected in Poland.

Surveys carried out by Bergström *et al.* [31] in the area of the "Lillgrund" OWF located in the Sund Spit showed a visible aggregation in the area of the project of fish species such as the cod, shorthorn sculpin, black goby, viviparous eelpout and eel. The assessment of whether the artificial reef effect is limited only to attracting fish to its area from the nearby sea area or whether there is a real increase in productivity is ambiguous. The results of surveys conducted by Reubens *et al.* [348] carried out in the area of Belgian wind farms located in the North Sea show not only the accumulation of cod in these areas, but also the increase in local production. However, it was limited to the area in the immediate vicinity of the OWF, and this effect was not visible on a regional scale. If there are no restrictions on fishing in the OWF region, there may be a situation where large groups of fish attracted by favourable living conditions will become an easy fishing target. As a result, it may lead to a reduction of fish resources and biodiversity in the area adjacent to the wind farm [158].

The results of surveys on the long-term impact of the Horns Rev 1 OWF on the abundance and taxonomic composition of fish showed that the artificial reef effect was significant enough to cause an increase in the number of fish that prefer a hard substrate and, at the same time, too small to cause a decrease in the number of fish that prefer a sandy substrate [389].

If possible restrictions on fishing and shipping are introduced in areas occupied by projects (e.g. wind farms), anthropogenic pressure will decrease and artificial reef areas may be a specific refuge for fish, both adult and their early developmental stages, larvae and fry, becoming an equivalent to protected areas [99].

It is possible that artificial reefs offering environmental conditions significantly different from those prevailing in a given area may constitute an environment facilitating invasion of foreign species [243]. However, the information available in literature concerns mainly the appearance of periphyton organisms and crustaceans. Nevertheless, it is possible that "artificial reefs" may create an environment that also favours foreign fish species.

The new habitat created as a result of the construction of the OWF, with its hard substrate and relatively rich food supply for benthivorous fish, may constitute a favourable environment for the colonisation by the invasive round goby *(Neogobius melanostomus)*.

Since the first report in 1990 on the introduction of the round goby to the Gdańsk Bay with the ballast waters of vessels, the presence of this species has been recorded in the Polish area of the Baltic Sea, both in deeper waters (up to 40−60 m), and in the zone of shallow waters of the coast, in the Pomeranian Bay and in the Vistula Lagoon and its tributaries.

The round goby spreads in new habitats also due to its tolerance to a wide range of changing environmental conditions such as depth, character of the substrate, salinity, oxygen scarcity, and diversified food supply. The spawning of the round goby takes place many times in several portions during the season at a depth ranging from 0.2 to 1.5 m on various substrates [443]. It can live in marine, brackish, but also freshwater environments [73]. Therefore, the greater depth of the OWF Area will not favour the reproductive processes of this species.

It is unlikely that the area of the planned project will be colonised by the round gobies migrating from coastal areas due to the lack of plankton larval stages and a limited range of movements of adult fish. This species rarely migrates far. The range of migrations is small and usually does not exceed

100 m [376]. The longest migrations take place in late autumn and early spring when fish move between shallow and deep waters [29].

The above information indicates that it should not be expected that this species will effectively inhabit the OWF Area.

The impact related to the change of habitat will be positive, direct, local, permanent and long-term.

The sensitivity to the impact for the cod, European flounder and herring was assessed to be high and for the sprat, common seasnail and sand goby as moderate. The significance of the impact is assessed to be negligible for all the fish species examined.

Barrier creation

The construction of underwater structures may constitute a migration barrier for economically important fish whose migration routes run through this place. The observations carried out in the areas of the Danish OWFs indicate that due to the possibility of an active movement of fish, these factors do not significantly disturb the migration processes [251].

The impact related to the creation of a barrier will be negative, direct, local, long-term and permanent.

The sensitivity to the impact was assessed to be moderate for all the fish species examined. The significance of the impact was assessed as negligible for all the fish species examined.

Electromagnetic field emission

Submarine cables through which electric current flows become a source of electromagnetic field. The current flowing through them generates a magnetic field, which in turn becomes a source of induced electric field. Direct emission of electric field occurs only in the case of solutions using the electrodes placed in the sediment [314, 71]. The nature of the electromagnetic field depends on the flowing current, the cable type and whether it is located on the sediment surface or covered with a layer of sediment. For the connections between turbines inside the OWF, solutions based on alternating current are used most often, while for the transmission of energy over larger distances (e.g. connection to the shore), both high-voltage direct current and alternating current lines are used. Depending on the cable type and its depth in the sediment, the range of magnetic impacts may vary from several to several hundred metres, whereas in the case of induced electric field it reaches several metres [310, 115].

The specific dimensions of the fields generated depend on the technical solutions applied. The spatial range of the induced electric field usually reaches up to several metres from its source [115, 310]. For the electric field resulting from the application of the electrode solution, the field strength of approx. 3 V/m above the electrode may be expected to be below 0.5 V/m at a distance of 40 m (assumptions: DC cable, 400 kV voltage, 1330 A current) [314].

The sensitivity of ichthyofauna to the impact of electromagnetic field depends on:

- the species-specific detection threshold;
- the type of sensor in the fish (magnetic, electrical);
- the lifestyle (demersal, pelagic – seabed dwellers are exposed to a higher force of the electromagnetic field) [115].

The magnetic field detection threshold is, depending on the species, between 0.01 µT and 0.05 µT.

According to Taormin *et al.* [404], the electromagnetic field generated by cables may affect navigation and orientation capabilities of marine organisms, cause avoidance or attraction effects, as well as cause physiological and developmental disturbances.

Disturbances in the natural field may cause problems with the orientation of migratory fish, such as European eel, the experimental surveys of which confirmed its sensitivity to changes in the magnetic field [212]. However, the previous field surveys do not indicate a significant impact of this factor on the migration capabilities of this species. During surveys carried out in the Southern Baltic, Westerberg and Öhman *et al.* [448, 306] did not observe any disturbances in the migration of eels swimming 500 m away from a wind power station. Also Westerbeg and Begout-Anras [450] did not find that the high-voltage DC cable constituted a barrier to migration of this species. Moreover, no significant impact of the long-term exposure of the European flounder to the increased constant magnetic field was observed [46].

Research on the impact of the electric field on salmonids and eels indicate the possibility of the occurrence of such reactions as accelerated pulse (field strength of 0.007–0.07 V/m) as well as gills and fins vibration (field strength of 0.5–7.5 V/m) [264]. Harmful effects such as paralysis and temporary loss of consciousness were observed in fish exposed to an electric field with a force above 15 V/m [24, 135].

The OWF Area is neither a spawning ground for the cod nor for the deep-water spawning European flounder dominant in this area. During ichthyofauna surveys the sprat spawning was found, but this sea area is small in comparison with the large areas of the spawning grounds of pelagic fish. Herring spawning may occur in the OWF Area, but it can be assumed that any disturbances in the reproductive process will not affect the recruitment of this species at the population level.

The impact related to the emission of electromagnetic field will be negative, direct, local, long-term and permanent.

The sensitivity to the impact was assessed to be moderate for all the fish species examined. The significance of the impact was assessed as negligible for all the fish species examined.

6.1.2.6.1.4 Marine mammals

During the Baltic Power OWF exploitation phase, the impacts on marine mammals will result from:

- the emission of noise generated by wind power stations;
- the emission of noise generated by vessels;
- habitat change;
- vessel collisions;
- collisions with vessels.

Noise generated by wind power stations

Underwater noise generated during the OWF exploitation phase comes mostly from vibrations generated by the generator and the gearbox, transferred through the foundation or support structure to water, and it is much lower than the noise generated during the OWF construction phase [32, 414, 421]. However, it should be noted that the noise emission will be present throughout the project, which may exceed 20 years.

The pre-2006 knowledge on emissions generated during the OWF operation was summarised by Madsen *et al.* [260] and Thomsen *et al.* [417]. Both studies showed that the existing wind farms increase the level of ambient noise only to a very limited extent and, consequently, their impact on marine mammals was assessed to be low.

Nedwell *et al.* [299] carried out a measurement campaign covering the OWFs in the exploitation phase: North Hoyle, Scroby Sands, Kentish Flats and Barrow located in the United Kingdom (pile diameter from 4 to 4.7 m). The studies concluded that the noise generated during their operation was very low and no evidence was found that the noise had reached a level that would have contributed to the avoidance of this area by marine mammals.

Tougaard *et al.* [421] measured operational noise from three smaller turbines (0.45−2 MW) in three OWFs: Middelgrunden and Vindeby in Denmark and Bockstigen-Valar in Sweden. Wind power station noise was measured only above the ambient noise level for the frequencies below 500 Hz, which are generally poorly heard by marine mammals [417]. They discovered that with the increase of wind speed, only the peak noise levels increase, not the frequency, as the turbines were kept in continuous rotation, which confirmed that the noise comes mainly from the gearbox. They also estimated a very small range for the noise heard by porpoises (< 100 m) and, depending on the propagation losses assumed, the audibility for seals ranged from 2.5 to 10 km from the source.

One of the most extensive studies of noise generated during the exploitation of the wind farm was the RAVE program (Research at Alpha Ventus), in which the operational noise of the Alpha Ventus wind farm in the North Sea was measured over a period of 165 days in 2010 and 2011 [32, 247]. The analysis focused on the operational noise of two wind power stations of different manufacturers, each with a rated power of 5 MW. For one of the turbines, a very characteristic 90 Hz tonal noise was measured with harmonics at 450 Hz, 630 Hz and 810 Hz (Figure 6.1), which dominated the operational noise of the wind farm, especially at the full operational load. However, contrary to expectations, this project also showed that in the area of the wind farm the noise quiesced with an increase in the wind speed and output power, as the background noise (e.g. from remote vessels) was obscured due to an increase in the sea level and this noise decrease more than compensated for the increase in the turbine noise. Based on this study, Betke [32] also suggested that although noise levels may increase as the turbine size increases, they are likely to be outside the frequency range which marine mammals hear.

As part of the MarVEN project [414], measurements were taken at two Belgian wind farms with 3 MW turbines on large-diameter steel piles (Belwind and Northwind) and one with 5 and 6.15 MW turbines on jacket foundations, the C-Power OWF [414]. The recordings revealed peaks at 50, 150, 400, 500 and 1200 Hz in 1/3 octave bands. The measurements were conducted at several distances from the source, and the values recorded from the Northwind OWF turbine were comparable to the measurements from the C-Power OWF. Noise measurements were significantly higher for Northwind when the distance increased to 150 m, which suggests that the type of foundation may also contribute to the noise level generated by wind power stations, especially at higher distances.

The noise modelling for the 6 MW wind farm carried out by Marmo *et al.* [265] has shown that, depending on the type of foundation or support structure and the wind speed, noise emissions from the modelled wind farm were detectable at a distance of up to 20 km from the source. However, these ranges were based on the levels of ambient noise from Venez [446], which is a very cautious approach as these levels are old and relatively low.

Noise levels from the tests described above have been standardised up to a distance of 25 m and are summarised in the table (Table 6.9).

Table 6.9. Recorded noise levels standardised up to a distance of 25 m. The water depths refer to the depths of the wind power stations subject to measurements, the entire wind farm or the measuring point and serve as guidance only. The 1/3 octave mid frequencies refer to the maximum sound pressure level of 1/3 octave. Appropriate distances for the specified sound pressure level were assumed as measuring distances. If the noise level has already been determined (e.g. for Alpha Ventus), the value is shown below. For North Hoyle, Scroby Sands, Kentish Flats and Barrow wind farms, measurements adopted were within or outside the wind farm [Source: internal materials]

Wind farm/ data source	Turbine rated power [MW]	Water depth [m]	Maximum broadband sound pressure level at a distance of 25 m [dB re 1 µPa]	Maximum 1/3 octave band levels at a distance of 25 m [dB re 1 µPa]	1/3 octave band middle frequency [Hz]	Measurement distance [m]	References
Vindeby	0.45	4	120	120	125	14	Tougaard et al. [421]
Bockstigen-Valar	0.5	10	109	106	160	20	Tougaard et al. [421]
Utgrunden	1.5	-	-	118	160	1	Thomsen et al. [415]
Middelgrunden	2	5	105	102	25	20	Tougaard et al. [421]
North Hoyle	2	12	125	-	-	Within the farm area	Nedwell et al. [299]
North Hoyle	2	12	117	-	-	Outside the farm area	Nedwell et al. [299]
Scroby Sands	2	5	127	-	-	Within the farm area	Nedwell et al. [299]
Scroby Sands	2	5	129	-	-	Outside the farm area	Nedwell et al. [299]
Northwind	3	20	135	-	-	40	Thomsen et al. [414]
Northwind	3	20	142	-	-	150	Thomsen et al. [414]
Kentish Flats	3	5	111	-	-	Within the farm area	Nedwell et al. [297]
Kentish Flats	3	5	110	-	-	Outside the farm area	Nedwell et al. [297]
Barrow	3	-	121	-	-	Within the farm area	Nedwell et al. [297]
Barrow	3	-	119	-	-	Outside the farm area	Nedwell et al. [297]

Wind farm/ data source	Turbine rated power [MW]	Water depth [m]	Maximum broadband sound pressure level at a distance of 25 m [dB re 1 µPa]	Maximum 1/3 octave band levels at a distance of 25 m [dB re 1 µPa]	1/3 octave band middle frequency [Hz]	Measurement distance [m]	References
Alpha Ventus	5	30	-	123	90	1	Van Radecke and Benesch [432]
C-Power	5	25	137	-	-	40	Thomsen et al. [414]
C-Power	5	25	131	-	-	60	Thomsen et al. [414]
C-Power	5	25	131	-	-	150	Thomsen et al. [414]

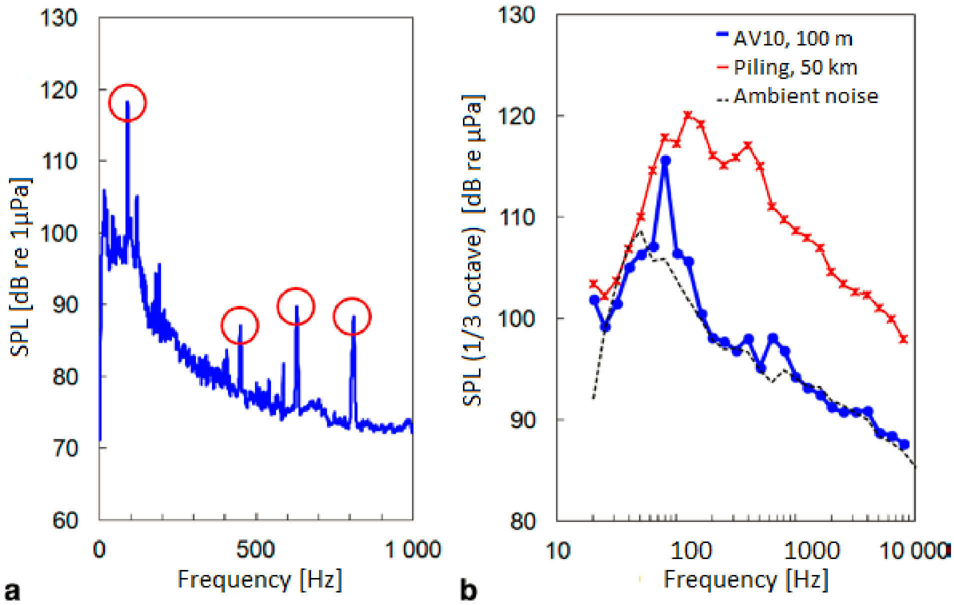


Figure 6.1. Noise from the 5 MW wind power station measured at a distance of 100 m from the Alpha Ventus offshore wind farm; a) noise spectral density – red circles indicate the tonal component at 90 Hz and harmonics at 450 Hz, 630 Hz and 810 Hz; b) noise spectrum in the 1/3 octave bands from Figure a (blue line), acoustic background at the same wind speed and without the operation of the turbines (dashed line) and the noise from remote piling (red line) [32] [Source: internal materials]

Although porpoises and seals may detect the noise originating from the exploitation of wind farms from closer distances than during piling, the number of marine mammals does not necessarily decrease in relation to the number observed before the construction phase. Scheidat *et al.* [367] demonstrated that in the Egmond aan Zee OWF, porpoises returned to the area of the OWF in exploitation in a greater number than in the surrounding control areas. They suggested that the area of the wind farm where vessel traffic and trawling are prohibited may be a refuge compared to areas with increased shipping. Artificial reefs increasing the possibility of feeding are also important. It is known that in the southern North Sea, where this wind farm is located, the number of porpoises has generally increased [322, 415]. An increase in the number of animals could simply follow a more general trend, which was not related to the wind farm. However, no similar increase in the number of porpoises was observed in the reference areas. During another research, within a 10-year monitoring period [405], a strong decrease in the number of porpoise detections was found after the construction of the Nysted OWF in the Danish part of the Baltic Sea. The level of porpoise detection was restored to 29% of the initial level probably due to positive effects accompanying wind farms (e.g. artificial reef effect). Teilmann *et al.* [407], on the other hand, did not state that the presence of wind power stations had an impact on the number of porpoises in the area of the Rødsand II OWF, which is located in the Nysted vicinity. It should be mentioned that in Nysted the acoustic activity of porpoises (number of detections) was relatively low from the beginning. Therefore, the results may not be representative due to the small size of the samples. To sum up, different types of wind farms under different environmental conditions may have different impacts on the distribution of porpoises in a given area.

The impact of OWF exploitation was also examined in the context of seals. The study prepared by Russell *et al.* [359] indicated that several marked harbour seals actively sought the foundations or support structures of wind power stations in the Alpha Ventus OWF (Germany) and Sheringham Shoal (United Kingdom), probably in order to search for food, as indicated by the pattern of their movement. McConnell *et al.* [271], on the other hand, noted that seals totally ignored the wind power stations of Nysted and Rødsand II wind farms, suggesting that, as in the case of porpoises, seals do not give an impression of being deterred and even, under certain conditions, are attracted to the wind farms.

The impacts will be of low importance in the case of porpoises, grey seals and harbour seals.

Noise generated by vessels

It is likely that small and medium-sized vessels will be used to service and maintain the OWF. These types of vessels emit sounds mainly between 160−180 dB re 1 µPa at 1 m, covering < frequencies from <1 kHz to 10 kHz. It is possible that they will lead to an increase of the local sound field during exploitation, including frequencies that are partially relevant for marine mammals. The total number of service and maintenance works on the wind farm is unknown. However, it is possible that only one vessel will be used at a time. Hence, the audible field and short-term impacts may be very limited locally, and therefore, the significance of the impact may be considered to be low.

Habitat change

The visual impact of the wind farm in exploitation under water will probably be minimal. Underwater parts of foundations or support structures and erosion protection are quickly overgrown, resembling other reefs present at sea. On the surface, wind power stations together with rotor blades represent a significant change in the surrounding landscape, but it is not clear whether and how this may affect porpoises and seals under water. On the other hand, the porpoise vision on the surface is poor and as for seals, although their eyesight is sharp, it is not known to what extent the view of wind power stations would scare them away.

Introduction of hard substrates in the form of foundations or support structures and erosion protection on the sandy seabed will cause changes in the environment and may have a positive effect over a longer period of time, as they can serve as artificial reefs or refuges with a lower noise level compared to areas with high vessel traffic intensity [367, 405].

Grey seals and harbour seals can benefit from the same effects of an artificial reef [359], and since the wind farm is not close to their haul-outs, habitat change will most likely not cause significant disturbances.

Vessel collisions

Vessel collisions causing oil spillage in the project area may adversely affect marine mammals present in adjacent waters. However, fuel spillage is very unlikely. It is also recommended to develop an oil spillage prevention plan and response procedures at different stages of the project. Given the above, the significance of this impact was assessed to be moderate for porpoises and seals.

Collisions with vessels

Collisions with vessels concern generally large whales. However, data suggest that this factor may also be a significant source of mortality among small whales in areas with high density and intense vessel traffic [433]. High speed ferries raise particular concerns due to the high speed with which they move (often above > 40 knots) and the relatively low noise levels they generate [68]. Collisions with vessels were also documented for seals, but in a small number and mostly concerning juveniles [156]. In the case of the Baltic Power OWF, collisions with vessels are unlikely due to low density of porpoises and seals in the area surveyed, as well as due to lower speeds of vessels participating in the OWF maintenance and servicing. The significance of this factor was assessed to be low for porpoises and seals.

Assessment of the significance of impacts during the exploitation phase

The results of the assessment of the impact of factors during the exploitation phase of the wind farm are presented in the table (Table 6.10). The effect on porpoises and seals is generally negligible, of low importance or moderate during the exploitation phase. In some cases, positive factors may even be indicated, such as the reef effect, which may contribute to greater opportunities for feeding for all species of marine mammals concerned [241].

Table 6.10. Overall effect on marine mammals associated with activities in the exploitation phase after application of the NRS [Source: internal materials]

Species	Impact	Impact description	Impact significance
Harbour porpoise *Phocoena phocoena*	Noise from operating turbines	Behavioural response to noise generated by wind power stations (moving away from the exploitation site)	Low
	Service and maintenance noise	Behavioural response to noise related to the service and maintenance of the OWF (moving away from the exploitation site)	Low
	Visual effects	Behaviour changes caused by obstacles (moving away from the exploitation site)	Low
	Reef effects	Increase in feeding opportunities due to increased fish abundance	Low
	Vessel collisions	Contamination caused by the collisions of vessel used during the exploitation phase (e.g. fuel spillage)	Moderate
	Collisions with vessels	Physical injuries caused by collision of marine mammals with vessels	Low
Grey seal *Halichoerus grypus*	Noise from operating turbines	Behavioural response to noise generated by wind power stations (moving away from the exploitation site)	Low
	Service and maintenance noise	Behavioural response to noise related to the service and maintenance of the OWF (moving away from the exploitation site)	Low

Species	Impact	Impact description	Impact significance
	Visual effects	Behaviour changes caused by obstacles (moving away from the exploitation site)	Low
	Reef effects	Increase in feeding opportunities due to increased fish abundance	Low
	Vessel collisions	Contamination caused by the collisions of vessel used during the exploitation phase (e.g. fuel spillage)	Moderate
	Collisions with vessels	Physical injuries caused by collision of marine mammals with vessels	Low
Harbour seal *Phoca vitulina*	Noise from operating turbines	Behavioural response to noise generated by wind power stations (moving away from the exploitation site)	Low
	Service and maintenance noise	Behavioural response to noise related to the service and maintenance of the OWF (moving away from the exploitation site)	Low
	Visual effects	Behaviour changes caused by obstacles (moving away from the exploitation site)	Negligible
	Reef effects	Increase in feeding opportunities due to increased fish abundance	Low
	Vessel collisions	Contamination caused by the collisions of vessel used during the exploitation phase (e.g. fuel spillage)	Moderate
	Collisions with vessels	Physical injuries caused by collision of marine mammals with vessels	Low

6.1.2.6.1.5 Migratory birds

During the Baltic Power OWF exploitation phase, the impacts on migratory birds will result, similarly as in the construction phase, from two main elements, i.e. the barrier effect and the risk of collision with the OWF structures. Due to the largest assumed occupation of space above the Baltic Power OWF Area, the size of these impacts will be higher than during the construction phase. Detailed assessment of the Baltic Power OWF impact on migratory birds during the exploitation phase is included in Appendix 4 to the EIA Report.

Impact on migratory birds is considered through the barrier effect and the risk of collision with the OWF components. As a result of the barrier effect, birds approaching the OWF perceive it as a barrier and change the direction of flight. Birds may adapt their flight to bypass the OWF, which makes their migration route longer. The analyses conducted indicate that in each phase of the project, the energy expenditure related to the extension of the migration route is minimal. The migration route is not the same for all individuals of a given species and differences resulting from individual selection of the route and the impact of weather phenomena may be greater than those resulting from the barrier effect, therefore the significance of this impact was considered negligible.

The impact in the form of the risk of collision, i.e. mortality as a result of collision with the OWF components, is presented in the form obtained as a result of modelling the total number of collisions of a given species in the spring and autumn seasons. Among all the species considered in this analysis, the significance of the risk of collision was determined at a moderate level for the common scoter and the common crane. In the case of the common scoter, the scenario with the maximum mortality due to collisions means the collisions of a maximum of 7 individuals in the season. For the common crane, the maximum mortality was estimated at less than 120 individuals in autumn in RAV, while the models for APV indicate a lower mortality by about 25% both in spring and autumn for all the clearance ranges tested. The significance of the impact in the form of the risk of collision was assessed to be low for the long-tailed duck and the velvet scoter. For these species, the estimated number of collisions did not exceed a few individuals. The estimated number of collisions for geese in the worst case scenario exceeded 70 individuals, but due to very large populations of species included in this category (estimated at more than 3.5 million individuals), the significance of the impact was assessed as moderate. For other species, the significance of the impact resulting from the risk of collision was assessed as negligible.

A summary of the analysis of the impact of the barrier effect and the risk of collision on migratory birds during the exploitation phase is presented in the table (Table 6.11).

Table 6.11. Summary of impacts of the Baltic Power OWF on migratory birds during the exploitation phase [Source: Baltic Power Sp. z o.o. data]

Species	Value/receptor significance	Impact	Reversibility of the impact	Magnitude of the impact	Impact significance
Long-tailed duck *Clangula hyemalis*	High	Barrier effect	Reversible	Insignificant	Negligible
		Risk of collision	Irreversible	Insignificant	Low
Common scoter *Melanitta nigra*	High	Barrier effect	Reversible	Insignificant	Negligible
		Risk of collision	Irreversible	Insignificant	Moderate
Velvet scoter *Melanitta fusca*	High	Barrier effect	Reversible	Insignificant	Negligible
		Risk of collision	Irreversible	Insignificant	Low
Geese *Anseridae*	Moderate	Barrier effect	Reversible	Insignificant	Negligible
		Risk of collision	Irreversible	Moderate	Low
Common crane *Grus*	High	Barrier effect	Reversible	Insignificant	Negligible
		Risk of collision	Irreversible	Moderate	Moderate

6.1.2.6.1.6 Seabirds

Identification of key factors affecting seabirds during the exploitation phase

The potential impact of wind power stations located in the offshore sea areas on seabirds relates to the increased mortality as a result of collisions with the wind power stations and changes in the distribution and behaviour of birds. The highest mortality occurs in the case of farms of wind power stations located on feeding grounds and on regular flight routes.

In order to determine the significance of the impact, the range of the impact was assessed as high for the long-tailed duck and velvet scoter, moderate for the razorbill and the common guillemot, and as insignificant for the European herring gull.

The identified factors and assessment of their impact on marine avifauna during the exploitation phase are presented below.

Vessel traffic

The presence of vessels and fixed structures protruding from the water shall result in a higher number of gulls and great cormorants that use such elements as resting sites and seek food in the vicinity of vessels. Three species of large gulls, including the most numerous European herring gulls, gather in the open sea around fishing vessels. If commercial fishing is reduced in this sea area during the wind farm exploitation, these gulls will move (at least partially) to other fishing sites.

The exploitation of the Baltic Power OWF will involve the traffic of various types of vessels, as well as helicopters servicing the OWF. Due to the fact that it is difficult to separate their impacts (unknown number of helicopters that can be used), these impacts are assessed jointly.

The traffic of vessels during the exploitation phase will cause direct negative impact on seabirds of local range (for the long-tailed duck of regional range, due to possible impact on the biogeographical population of this species), wich will be long-term, reversible, repeatable during the exploitation period, with intensity depending on the species.

The sensitivity to the impact for the European herring gull was assessed as low and for other species as high.

The significance of the impact varies for individual species and is assessed as negligible for the European herring gull, moderate for the razorbill and common guillemot, and high for both species of ducks, the long-tailed duck and the velvet scoter.

Scaring away and displacement from habitats

The exploitation of the OWF will result in scaring away and displacing part of seabirds from their habitats in the sea area occupied by the wind power stations and in the adjacent water strip with the width of approximately 2 or even 4 km. The degree and area of birds' displacement from this sea area and its surroundings will depend on bird species.

A single OWF is a barrier for birds, which, in the vast majority of cases, avoid the sea area with wind power stations. Such behaviour reduces the risk of collision, especially during the day when the visibility is good. However, the OWF Area will be excluded for a large part of the population as a feeding ground for a long time, which may have a negative impact on some species.

After the construction of the OWF, most bird species will avoid staying in its vicinity, as a result of which they will lose access to their feeding grounds.

The most important parameters influencing the level of impact are:

- the number of wind power stations;
- the density of wind power stations;
- the clearance between the sea surface and the lower level of the rotor blade (most flights take place up to 20 m above the water surface);
- the rotor diameter;
- the distance from the neighbouring OWFs – adjacent wind farms increase the barrier effect.

Scaring and displacement from the habitat during the exploitation phase will cause direct negative impact on seabirds of local range (for the long-tailed duck of regional range, due to possible impact on the biogeographical population of this species). For the razorbill, common guillemot, European herring gull and velvet scoter, this is a long-term and permanent impact, and for the long-tailed duck – short-term and temporary.

The sensitivity to the impact for the European herring gull was assessed as low and for other species, it was assessed as high.

The significance of the impact varies for individual species and is assessed as negligible for the European herring gull, moderate for the razorbill and common guillemot, and high for both species of ducks, the long-tailed duck and the velvet scoter.

Barrier creation

The structures of wind power stations will occupy a part of the OWF sea area, creating a barrier for seabirds flying locally between feeding or resting grounds, which reluctantly fly over obstacles. The range of the barrier effect will depend on the number and size of the wind power stations erected. However, the selection of the variant will not have a significant impact on the size and significance of the project impact on seabirds. It is noted that seabirds clearly avoid the area occupied by wind power stations and their population decreases in the vicinity of wind power stations, e.g. for the long-tailed duck within a radius of up to 2, and even up to 4 km [76, 323,254]. The only exceptions are the European herring gulls and great cormorants, which often use structures protruding above water as places of rest, so that their number may even increase.

The barrier effect that will be created by the Baltic Power OWF applies primarily to migratory birds. A part of seabirds migrating through the OWF Area may, however, target the nearby Natura 2000 sites of the Słupsk Bank, Przybrzeżne wody Bałtyku and Pobrzeże Słowińskie, where they may have their stopover sites, wintering or breeding grounds. The creation of an uninterrupted barrier in this area may also hinder the movement of these populations between the closest similar wintering sites, such as the Słupsk Bank, Middle Bank and Hoburgs bank. Today, there are no scientific data on the significance of connections between these areas, but they cannot be dismissed.

The new structures present during the exploitation phase of the OWF will be the source of direct negative impacts on seabirds that will be of local range, long-term, reversible, permanent during the exploitation phase, and their intensity will dependent on the species.

Operating wind power stations will create a physical barrier, causing the risk of collision and, on the other hand, deterring birds and causing the loss of feeding grounds. The bird deterrent effect of wind farms minimises the risk of collisions. However, the risk of collision applies to migratory birds flying at night and in conditions of limited visibility rather than to birds staying within the project area.

Creation of a barrier during the exploitation phase will cause a direct negative impact on seabirds of local range (for the long-tailed duck of regional range, due to possible impact on the biogeographical population of this species). For the razorbill, common guillemot, European herring gull and velvet scoter, this is a long-term and permanent impact, and for the long-tailed duck – a short-term and temporary one.

The sensitivity to the impact for the European herring gull was assessed as low and for other species as high.

The significance of the impact varies for individual species and is assessed as negligible for the European herring gull, moderate for the razorbill and common guillemot, and high for both species of ducks, the long-tailed duck and the velvet scoter.

Collisions with wind power stations

During the exploitation phase of the planned project, collisions of seabirds with vessels may occur. However, due to the higher intensity of vessel traffic in the OWF Area during the construction and decommissioning phases, this impact will be the smallest during the exploitation phase of the planned project. Along with the progressing construction of the OWF, the risk of bird collision with wind power stations will increase. It will reach its peak during the OWF exploitation phase.

Wind power stations cause changes in the way birds use space, which also applies to offshore areas. In the vast majority of cases, wind power stations scare the birds away and the passing water birds bypass wind power station areas at a distance from 100 to even 3000−4000 m [76, 323, 254]. As a consequence, the areas directly adjacent to the wind power station are much less used as feeding grounds and resting sites. The area where the wind farm masts stand, ceases to be available as a feeding ground for birds to a large extent, and, in some cases, significantly lower density of birds can be observed at a distance of up to 2 or even 4 km from the wind farm [324]. The fact that water birds avoid the area where wind power stations are located and the low altitude of the flights between the masts reduce the risk of collisions, resulting in low mortality caused by collisions with offshore wind power station structures. However, with poor visibility caused by fog and rainfall, the risk of collision increases. The number of collisions with wind power stations increases significantly when they are located in areas attractive to birds and densely populated, and when the wind power stations are located on the routes of regular migration or local passages.

The risk of collision also depends on the species of birds. Large water bird species, such as swans, are more vulnerable to collisions with wind power stations due to difficulties in carrying out rapid mid-air manoeuvres [63]. Most species of seabirds fly low above the water and, when they are between wind power stations, they lower their flight altitude and maintain equal distances from obstacles [101, 187, 323]. This means that the risk of collision is influenced by the clearance between the lower position of the rotor blade and the sea surface. The smaller it is, the greater the chance of birds colliding with an operating rotor.

Collisions with wind power stations during the exploitation phase will cause direct negative impact on seabirds of local range (for the long-tailed duck of regional range, due to possible impact on the biogeographical population of this species). For the razorbill, common guillemot, European herring gull and velvet scoter, this is a long-term and permanent impact, and for the long-tailed duck – a short-term and temporary one.

The sensitivity to the impact for the European herring gull was assessed as low, for the razorbill, common guillemot and velvet scoter as moderate, and for the long-tailed duck as high.

The significance of the impact varies for individual species and is assessed as negligible for the European herring gull, low for the razorbill and common guillemot, moderate for the velvet scoter and high for the long-tailed duck.

Creation of an artificial reef

Habitat changes caused by the creation of an artificial reef may have a certain positive impact on benthivorous seabirds thanks to an increase in the food supply. Rich benthic communities are formed on the underwater parts of the structure and at the seabed of the sea area occupied by the OWF, which may result in an increase in the number of fish. However, these resources will be little or not at all exploited by birds. The deterrence effect on birds of the structures protruding high above the water will prevail there. The most important parameters affecting the impact level are the shape, base diameter and number of foundations or support structures.

The sensitivity to the impact for the European herring gull was assessed as negligible, for the razorbill and the common guillemot as moderate, and for the long-tailed duck and the velvet scoter as high.

The significance of the impact varies for individual species and is assessed as negligible for the European herring gull, low for the razorbill and common guillemot, and as high for both species of ducks, the long-tailed duck and the velvet scoter.

Establishment of a closed sea area

The OWF Area may be, during the exploitation phase, totally or partially closed for commercial fishing. In the case of such partial or complete closure of the sea area, it can be expected that fish will find very good living conditions in the OWF Area (no fishing, rich benthic communities). However, birds will benefit to a small extent from thus created food supply due to the prevailing deterrent effect of structures protruding high above the water.

The sensitivity to the impact for the European herring gull was assessed as negligible, for the long-tailed duck and velvet scoter as moderate, and for the razorbill and common guillemot as high.

The significance of the impact varies for individual species and is assessed as negligible for the European herring gull and moderate for other species.

The table (Table 6.12) presents a summary of the significance of individual impacts of the Baltic Power OWF on seabirds during the exploitation phase.

Table 6.12. Significance of the project impact on seabirds during the exploitation phase

Species	**Impact**	**Impact description**	**Impact significance**
European herring gull *Larus argentatus*	Establishment of a closed sea area	The OWF Area may be partially closed for fishing	Negligible
	Vessel and helicopter traffic	Scaring caused by the traffic of vessels, helicopters	Negligible
	Creation of an artificial reef	Creation of a new hard substrate for macrozoobenthos	Negligible
	Scaring away and displacement from the habitats	Caused by the operation of wind power stations	Negligible
	Barrier creation	Depending on the number of wind power stations, light and noise emitted	Negligible
	Collisions with wind power stations	Depending on bird migrations, density, flight altitude, OWPS parameters	Negligible
Razorbill *Alca torda*, Common guillemot *Uria aalge*	Establishment of a closed sea area	The OWF Area may be partially closed for fishing	Moderate
	Vessel and helicopter traffic	Scaring caused by the traffic of vessels, helicopters	Moderate
	Creation of an artificial reef	Creation of a new hard substrate for macrozoobenthos	Low
	Scaring away and displacement from the habitats	Caused by the operation of wind power stations	Moderate
	Barrier creation	Depending on the number of wind power stations, light and noise emitted	Moderate
	Collisions with wind power stations	Depending on bird migrations, density, flight altitude, OWPS parameters	Low
Velvet scoter *Melanitta fusca*	Establishment of a closed sea area	The OWF Area may be partially closed for fishing	Moderate
	Vessel and helicopter traffic	Scaring caused by the traffic of vessels, helicopters	High
	Creation of an artificial reef	Creation of a new hard substrate for macrozoobenthos	High
	Scaring away and displacement from the habitats	Caused by the operation of wind power stations	High

Species	Impact	Impact description	Impact significance
	Barrier creation	Depending on the number of wind power stations, light and noise emitted	High
	Collisions with wind power stations	Depending on bird migrations, density, flight altitude, OWPS parameters	Moderate
Long-tailed duck *Clangula hyemalis*	Establishment of a closed sea area	The OWF Area may be partially closed for fishing	Moderate
	Vessel and helicopter traffic	Scaring caused by the traffic of vessels, helicopters	High
	Creation of an artificial reef	Creation of a new hard substrate for macrozoobenthos	High
	Scaring away and displacement from the habitats	Caused by the operation of wind power stations	High
	Barrier creation	Depending on the number of wind power stations, light and noise emitted	High
	Collisions with wind power stations	Depending on bird migrations, density, flight altitude, OWPS parameters	High

6.1.2.6.1.7 Bats

The potential impact of the Baltic Power OWF on migratory bats during the exploitation phase will be caused by:

- the collisions with wind power stations;
- the emission of noise and light;
- the barrier effect;
- the habitat change.

Collisions with wind power stations

Studies show that in the late summer, wind power stations in the Baltic Sea at a distance of up to 10 km from the Swedish coast attract bats [2]. Increased activity of bats probably results from a high concentration of the food supply, which entices bats migrating over the Baltic Sea. Additionally, species of bats that do not migrate seasonally may be attracted to the OWF Area [361, 370].

Bats may collide with masts or rotor blades, there is also a risk of barotrauma. Barotrauma is caused by the low-pressure produced by rotating rotors. The studies showed that most of the bats killed in the area of onshore wind power stations are likely to be lost due to internal injuries caused by barotrauma [21, 159].

Migratory bats fly over the sea at low altitudes. However, if they come across a wind power station, they can change the flight height from the water surface to the top of the wind power station within only a few seconds [2]. Moreover, bats may be enticed by the concentration of a food supply accumulating around wind power stations in favourable weather conditions, such as low wind speeds, high temperatures, lack of precipitation [329]. Insects can be attracted by a temperature growth due to the operation of the wind power station. Wind power station towers absorb heat during the day, thus attracting insects the concentration of which constitute an attractive feeding ground for bats [363]. Insects may gather at the top of the wind power station as a result of the phenomenon known *as* hill-topping [363]. The phenomenon is associated with the migration of insects that, when coming across an obstacle like an OWPS, move upwards along the obstacle and gather at its top. As a result, bats, thus lured, may be more exposed to collisions as a result of hitting the rotor blades.

Most bats migrate over the sea at night when the wind speed does not exceed 10 $m \cdot s^{-1}$, while the highest activity of bats is recorded at the wind speed below 5 $m \cdot s^{-1}$ [3]. The highest feeding intensity of bats was observed during windless weather. Very low wind speeds are rare in the open sea. Therefore, it is rather unlikely that bats will gather for feeding on days of the OWPS operation.

Emission of noise and light

Ultrasonic noise generated by the nacelle may attract bats, but this hypothesis has not been confirmed and seems unlikely [363]. The same applies, according to Rydell *et al.* [363], to the assumption that the red warning lights of wind power stations entice bats. However, it has been proven that red light is more attractive to bats than the white one [438]. Taking into account the fact that the alleged impact of noise and light emission on bats is considered unlikely, the effects of these impacts are classified as local and permanent, but of low intensity, which results in minor structural and functional changes for bats.

Barrier effect

The operating wind farm may exert a barrier effect on migrating bats. Noise emitted by operating wind power stations can contribute to the barrier effect. Due to the barrier effect, bats may be forced to change the migration direction. This, in turn, will result in additional energy expenditure disadvantageous to migratory bats [128].

Habitat change

Structural elements can be used as resting sites along the migration route or can be attractive hiding places due to the aforementioned insect concentrations [2, 363].

Surveys in the spring and autumn migration periods indicated a possibility of bats migrating through the OWF Area, but the migration intensity was low due to the low activity of bats.

The Baltic Power OWF impacts presented for the exploitation phase will be negative, direct, and long-term.

Sensitivity to the impact was assessed as low, whereas the significance of the Baltic Power OWF impact during the exploitation phase was assessed as negligible due to the low activity of bats found during the surveys carried out in the seasonal migration periods.

6.1.2.6.2 Impact on protected areas

6.1.2.6.2.1 Impact on protected areas other than Natura 2000

Given the location of the Baltic Power OWF at a significant distance from the protected area of the Słowiński National Park, similarly as in the construction phase, no significant impact on this area, including any element for which it was established, i.e. biodiversity, resources, objects and components of inanimate nature and landscape values of the Park, will occur during the exploitation phase.

In the Appendix to the Ordinance of the Minister of the Environment of 16 February 2017 on the protection tasks of the Słowiński National Park (Official Journal of the Minister of the Environment of 2017, item 10, as amended), in which the existing and potential internal and external threats and methods of elimination or mitigation of these threats and their effects were identified and assessed, the existing external threats category indicates the risk resulting from increasing the areas for construction of wind farms in the municipalities adjacent to the Park. In the category of potential external threats, only the construction of wind farms in the buffer zone of the Park was indicated as constituting a potential external threat, and therefore, it should be stated that the Baltic Power OWF will not pose a threat to the Słowiński National Park.

6.1.2.6.2.2 Impact on Natura 2000 sites

Identification and assessment of impacts on protected areas within the European Natura 2000 network is presented in subsection 6.3.

6.1.2.6.3 Impact on wildlife corridors

The issue of wildlife corridors in maritime areas is described in subsection 6.3.

Due to the same pre-conditions in terms of knowledge about wildlife corridors in maritime areas and the spatial scale of the Baltic Power OWF Area in relation to the size of the Baltic Sea, including the permanent impact of space development, it was assessed that the impact of the Baltic Power OWF on migration routes of migratory species, considered separately for the exploitation phase, similarly as in the construction phase, will be negligible.

6.1.2.6.4 Impact on biodiversity

Phytobenthos and macrozoobenthos

During the Baltic Power OWF exploitation phase, structures permanently submerged in water will be founded in the environment, creating favourable conditions for the development of animal and plant periphyton organisms. On a local scale, within the structural elements area, there will be an increase in species diversity, although the character of natural value of this habitat may be ambiguous. This results from the fact that, on the one hand, periphyton complexes will be a new biocenosis component of this area, additionally increasing the food supply for fish, birds and, incidentally, for marine mammals. On the other hand, this location may favour the spread of non-native species, which lowers the ecological quality of this micro-habitat.

Ichthyofauna

The artificial reef effect present during the exploitation phase will probably result in an increase in biodiversity due to the appearance of a new habitat providing favourable conditions for the existence and reproduction of many fish species. The results of the surveys on the long-term impact of the Horns Rev 1 OWF on the abundance and taxonomic composition of fish showed that the artificial reef effect was significant enough to cause an increase in the number of fish that prefer a hard substrate and, at the same time, too small to cause a decrease in the number of fish that prefer a sandy substrate [389].

Possible reduction or cessation of fishing in the OWF Area due to legal regulations or navigation problems may have a positive impact on diversity. Probably, the artificial reef effect will have only a local impact, without increasing diversity within a larger area.

Marine mammals

The Baltic Power OWF exploitation phase will not have a negative impact on the biodiversity of marine mammals in the area surveyed and the adjacent waters. On the other hand, the reef effect may contribute to an increase in the number of fish living in the area surveyed, and consequently also of marine mammals.

Seabirds

The analysis of possible impacts resulting from the exploitation of the OWF indicates that their effects in terms of changes in biological diversity of seabirds will be local.

It will consist in potentially increased mortality as a result of collisions with wind power stations or vessels. The highest mortality occurs in the case of wind farms located on feeding grounds and on regular flight routes. The risk of collision also depends on the species of bird. Large seabird species, such as swans, are more vulnerable to collisions with wind power stations due to the difficulties in carrying out rapid mid-air manoeuvres [63].

Moreover, another identified threat to biodiversity is scaring away and displacing part of seabirds from their habitats in the sea area occupied by the wind power stations and in the adjacent water strip with the width of approximately 2 or even 4 km. The degree and area of birds' displacement from this sea area and its surroundings will depend on bird species. During the exploitation phase, this will cause direct negative impact on seabirds of local range (for the long-tailed duck of regional range, due to possible impact on the biogeographical population of this species). This impact depends on the number of the wind power stations and substations operated and the related number of vessels used for their maintenance, with the emission of light and noise being another scaring factor. In the first season of exploitation, birds will gradually get used to the situation in which the sea area intended for the project becomes inaccessible to them (habituation process), which will result in changes in their distribution. Therefore, this period can be treated as a transition one and only in the second year after the entire project construction completion the scale of the impact of the Baltic Power OWF on the seabirds staying in this region will stabilise. However, the habituation will not cause birds to return to the area occupied by the wind farm.

The barrier created by the Baltic Power OWF applies primarily to migratory birds. However, a part of seabirds migrating through the OWF Area may target the Polish Natura 2000 sites, where they may have their stopover places and wintering sites. The creation of an uninterrupted barrier in this area may also hinder the movement of these populations between the closest similar wintering sites, such as the Słupsk Bank, the Middle Bank and the Hoburgs bank. Currently, there are no scientific data on the significance of the links between these areas, but they cannot be excluded on the basis of the precautionary principle. The range of barrier effect will depend on the number and size of wind power stations constructed. Seabirds clearly avoid the area occupied by wind power stations and their population decreases in the vicinity of wind power stations – e.g. for the long-tailed duck within a radius of up to 2, and even up to 4 km [76, 323 254]. The only exceptions are European herring gulls and great cormorants, which often use structures protruding above the water as resting places, so that their number may even increase. This impact may be significant for species of seabirds sensitive to them, which may have a negative impact on biodiversity in the OWF Area.

To sum up, the impact of the OWF on biodiversity concerning seabirds coincides largely with the effect of the loss of their habitats.

6.1.2.7 Impact on cultural amenities, monuments and archaeological sites and objects

Since no risk of impact on the objects of great importance for the protection of cultural heritage has been established for the OWF Area, therefore, there is no justification for specifying the monitoring activities in this respect. It has not been excluded that the wrecks reported to the Pomeranian Provincial Monument Conservator will be put under conservator's protection and will require special avoidance zones to be determined in which the construction possibility will be restricted. If such protection zones are not established by the time of the construction design preparation, the Applicant assumes the preventive restriction of activities related to the seabed (systems, anchoring, foundations) at a distance of up to 100 m from the reported wrecks.

6.1.2.8 Impact on the usage and development of the sea area and on material goods

During its exploitation, the Baltic Power OWF Area will be excluded from regular navigation due to safety reasons. Traffic of other vessels (fishing, research or tourist vessels) may be permitted depending on the location of offshore wind power stations under the conditions agreed upon with investors. Decisions on permits for vessels other than the vessels servicing the OWF in the Baltic Power OWF Area will be made by the relevant maritime administration authorities.

Exclusion of the Baltic Power OWF Area from the possibility of free passage by fishing vessels may result in extension of their routes to and from the fisheries. However, taking into account the location of the Baltic Power OWF in relation to the shortest routes to fisheries in the area of the Słupsk Furrow from the ports in Władysławowo and Łeba, the extension of these routes may occur only after taking into account subsequent areas of the planned OWF. In no manner will the exclusion from free passage through the Baltic Power OWF Area affect fishermen from other ports fishing in the Słupsk Furrow area. This is described in detail in the subsection 7.4.3.4.

As a result of the Baltic Power OWF occupying the maritime area, this area may be excluded from the possibility of fishing. The Baltic Power OWF Area is located within four fishing squares. This area is characterised by low fishing productivity; therefore the significance of the impact was assessed to be low.

6.1.2.9 Impact on landscape, including the cultural landscape

During the OWF exploitation phase the following potential impacts of the project on the landscape, including the cultural landscape, were identified:

- operating offshore structures such as wind power stations, collection stations, export station;
- vessel traffic required for the OWF exploitation.

Objectively the landscape within the OWF will be industrial, but its impact will also be subjective and will depend on individual characteristics of the receptor and may be perceived negatively, positively and indifferently.

The impact of the OWF on the landscape during the exploitation phase depends on:

- the size of structures, the diameter of the rotor and its position in relation to the viewer;
- the number and location of wind power stations and facilities;
- the traffic of vessels related to the exploitation of the OWF;
- meteorological conditions and the sea state;
- location of the landscape observer.

The offshore structures will operate in an open sea area for over 20 years.

In the OWF Area, people not directly associated with the OWF are present temporarily. During the exploitation phase, these will include employees on board vessels used, among others, for regular servicing of the OWF, as well as passengers of tourist ferries, fishermen and deep-sea anglers, tourists on recreational craft, participants in search and rescue operations flying over the sea in airplanes and scientists. The planned OWF will be most visible to these groups but more people will be able to observe the OWF during the day rather than at night, when, for example, some of ferry crews and passengers will be asleep. The impacts on the landscape will be long-lasting, approx. 20 years and temporary, since after the completion of the exploitation the OWF is to be decommissioned.

In this phase, it is important for how long the observer will be able to see the OWF. It is expected that the above-mentioned people will stay in the area from which the OWF will be best visible, occasionally, some of them only once.

Meteorological conditions, and more specifically, the visibility understood as the extent of perceptibility of and the ability to differentiate facilities depending on weather conditions, are the basic factor which will determine whether wind power stations will be visible from the coastline or not. The figure below (Figure 6.2) shows the number of hours per year for a given visibility (how often the visibility is greater than a specific value) based on data from the atmospheric model UMPL (Unified Model for Poland) (calculated by the University of Warsaw Interdisciplinary Centre for Mathematical and Computational Modelling – data from approx. 5 years). These values are shown for 4 locations – Łeba, Lubiatowo, Dębki and Jastrzębia Góra. The graphs clearly show that in the case of Jastrzębia Góra there will be no situation in which the OWF will be visible from this place. In the case of Łeba, single wind power stations may be visible even for approx. 5000 hours per year, but 100% of wind power stations installed in the Baltic Power OWF may be visible for a very short period of time (several dozen hours per year). In the case of Lubiatowo, single wind power stations may be visible for more than 5000 hours per year, and all wind power stations installed in the Baltic Power OWF may be visible for up to 500 hours per year. The observer from Dębki can see single wind power station for more than 1000 hours per year, but in practice they will never see all wind power stations.

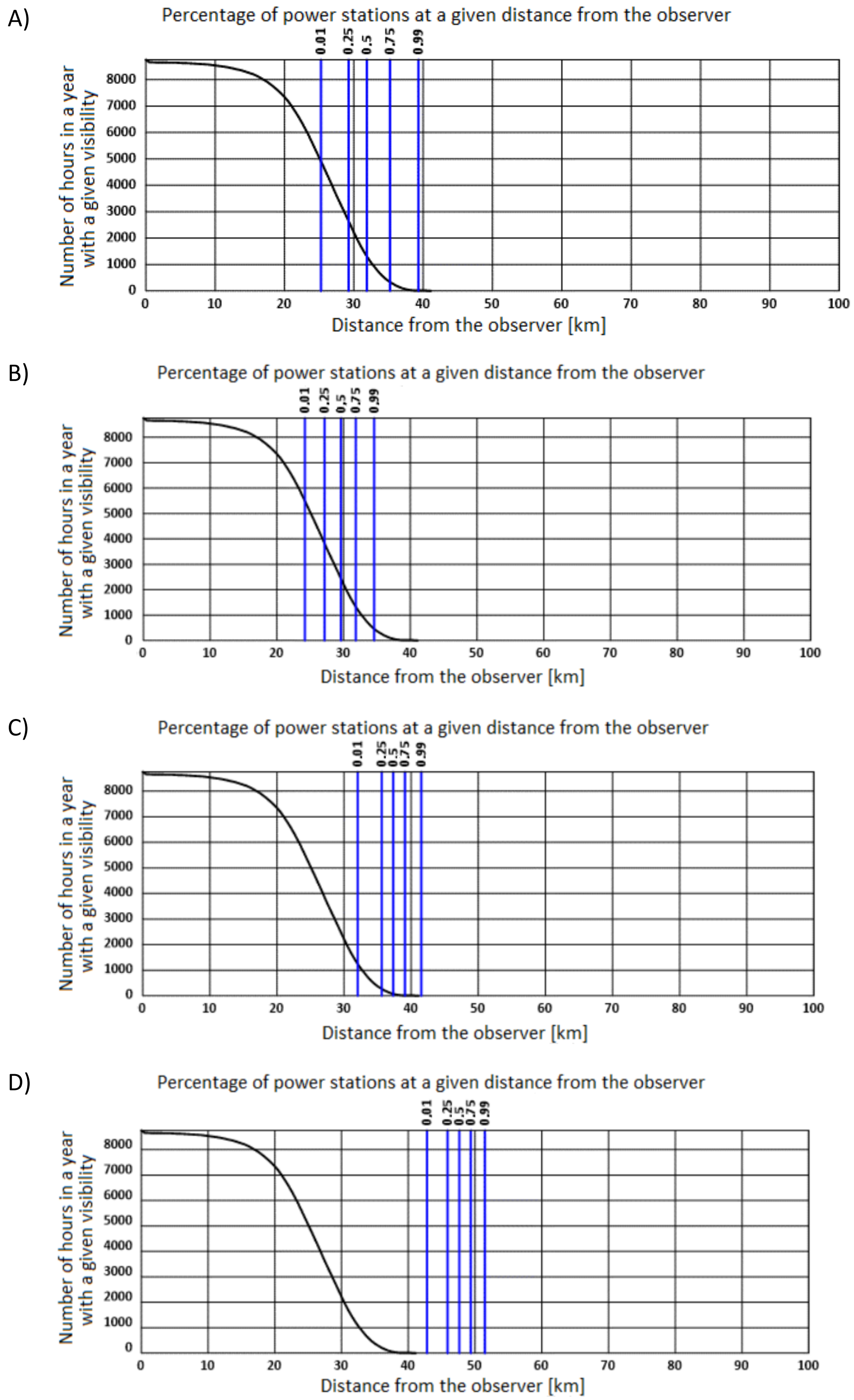


Figure 6.2. Number of hours per year for the preset visibility (distance from the observer) together with the distances of offshore wind power stations marked in the Applicant Proposed Variant (assumed total number of offshore wind power stations and other large-size structures – 132); Graph A – Łeba, B – Lubiatowo, C – Dębki, D – Jastrzębia Góra [Source: internal materials]

Additionally, the restriction related to the visibility of wind power stations from the mainland is curvature of the Earth and the related limitation of the height of facilities that can be seen from a large distance. In practical terms, this limitation manifests itself by the phenomenon that the further the offshore wind power stations are located from the observer, the fewer of them can be seen. However, the planned structures are so large that the number of wind power stations/structures visible will be influenced by atmospheric visibility and not by the Earth's curvature. Photographs [Photo 6.1, Photo 6.2] show the visualisation of the view on the Baltic Power OWF from Lubiatowo and Dębki. The visualisations on a larger scale are shown in Appendix 5 to the EIA Report and are saved in the form of graphical files on a disk.

Photo 6.1. Visualisation of the view on the Baltic Power OWF from Lubiatowo (summer season) [Source: Baltic Power Sp. z o.o. data]

Photo 6.2. Visualisation of the view on the Baltic Power OWF from Dębki (autumn season) [Source: Baltic Power Sp. z o.o. data]

In the Applicant Proposed Variant, the maximum height of an OWPS may be 330 m, and the maximum rotor diameter may be 260 m. Both parameters are greater than those assumed for the RAV, but for an observer, for example on board of a vessel, it will not be a noticeable, significant difference. Also due to the distance of more than 23 km from the land, the height of several dozen metres will not be noticed as differentiating.

From land, the highest parts of the OWF structure will be visible on the horizon line, under favourable weather conditions, i.e. very good visibility. For most days of the year, the OWF will be practically invisible. The potential zone of the OWF impact on the landscape includes an area of land from Wicko in the west to Jastrzębia Góra in the east. Whether the OWF will be visible to people on the mainland, it will depend on the place from where they will observe the sea. For people on the beach the OWF will be less visible than for people staying at a higher altitude above sea level, for example in such places on the coast as: Ustka, Rowy, Czołpino lighthouse, dunes in the Słowiński National Park, Łeba, Stilo lighthouse or Jastrzębia Góra. For each of the observers staying on the mainland, in good visibility conditions, the OWF will be visible on the horizon [Photo 6.1, Photo 6.2]. The operating OWF will not have a negative impact on the onshore forms of nature and landscape protection.

During the exploitation phase of the Baltic Power OWF, which will be located at a distance of over 23 km from the shore, it will not cause any impact on land, such as the effect of the rotation of the rotor blades, the flickering of light or noise, because they occur only close to the operating structures and their range will not reach the mainland. The offshore structures will be painted, marked, and illuminated at night due to the necessity to ensure maritime and aviation safety.

The significance of the impact was assessed as negligible, although it varies depending on the distance of the observer from the OWF. In the open sea, the landscape is not disturbance-resistant, but its value is not high, as very few people and over a short period will be exposed to the landscape change and some of them (e.g. tourists) may perceive it as advantageous or interesting. The scale of impact will have a large spatial range but the further the distance from the OWF the smaller it will be. It will be a long-term but reversible change. On the mainland, the upper parts of the OWF may be visible occasionally [Photo 6.1, Photo 6.2].

The visualisation of the view on the Baltic Power OWF is included in Appendix 5 to the EIA Report.

6.1.2.10 Impact on population, health and living conditions of people

The start-up and operation of subsequent OWPSs requires regular maintenance services. During exploitation, the scheduled inspections and interventions undertaken as a result of faulty operation shall cover, for instance: OWPSs, foundations or support structures of the OWF, substations and submarine cables. These activities will be carried out with the use of, among others, specialist vessels, helicopters, service vessels, working boats, underwater vehicles. During the Baltic Power OWF exploitation, the number of passages of vessels servicing the OWF may reach approx. 1000 per year. These vessels will move mainly between the ports of the central coast and the OWF Area. The number of possible passages on the route the Bay of Gdańsk – the Baltic Power OWF – the Bay of Gdańsk during the exploitation phase will be much smaller, about one hundred per year.

Regular services provided to the OWF during the exploitation phase will consolidate changes in the navigation of seagoing vessels. The intensity of vessel traffic between service ports of the central coast will be close to the maximum during the construction phase, which will have an adverse impact on the risk of emergency events.

For safety reasons, access to the Baltic Power OWF Area may be limited for fishing vessels and may mean, for instance, limitation of availability to the currently exploited fisheries and extension of the routes for fishing vessels from certain ports to the fisheries located north of the Baltic Power OWF Area. The range of these impacts will apply to several dozen fishing boats, mainly from the ports in Łeba and Władysławowo.

One of the types of sea fishing is recreational fishing practiced by both seagoing fishermen and angling enthusiasts and by the owners of sport and recreational vessels. In these cases, it is a small group of people whose material situation will deteriorate due to the construction and exploitation of the Baltic Power OWF.

The living standards of coastal cities, municipalities and settlements depend to a large extent on the development of coastal tourism and recreation. In some municipalities, e.g. Łeba, the income of local government and inhabitants is mostly derived from services provided to tourists and qualified tourism and recreation. The tourist and recreational potential of this part of the Baltic coastline is one of the highest in the country, and thousands of inhabitants provide various services to tourists mainly during the summer season, with a tendency to extend the holiday season.

Due to a large distance from the coast (approx. 23 and more kilometres), noise from wind power stations and service vessels will not reach the coastal zone. During most of the weather conditions (wind, wave motion, cloud cover, air humidity), the operation of the Baltic Power OWF will not be noticeable from the level of the beach or dunes. Only from higher viewing points and under suitable visibility conditions, it will be possible to observe a larger number of wind power stations (parts of the tower and the rotor). The number of visible wind power stations will depend on their spacing, alignment and distance from the coastline.

The weather conditions, in the case of such long distance, will cause the maximum reduction of the shadow impact onshore. However, the elements of the OWF lighting will be well visible at night from the shore along the long section of the coast.

Human health and life are related to direct or indirect impacts linked to the emissions of noise, air pollution, electromagnetic fields and radiation as well as wastewater and waste.

Mostly, these impacts will not have any significant impact on human health and living conditions due to their separation from the facilities and systems. Due to the occurrence of electromagnetic fields originating from the equipment at offshore substations and the transmission power of radiolocation and radio communication equipment, a potential hazard will be present during the entire period of operation of substations for the maintenance personnel of such equipment. Bystanders will never be within the range of electromagnetic impact of this equipment. People staying within the Baltic Power OWF Area because of their work duties will be subject to the provisions of the labour law and OHS regulations. Therefore, in case of the occurrence of the above-mentioned emission hazards, they will be provided with personal protection equipment or their working time in such conditions will be optimised accordingly so that the exposure does not exceed the time permitted by the OHS regulations.

Other types of events that may affect health and living conditions may involve different types of collisions of vessels at sea. Such events are random by nature, and the exploitation of the OWF may hinder the rescue operations at sea.

Although the resource such as population, health and living conditions of people, is of great value, due to the fact that the distance of the Baltic Power OWF from permanent places of residence and work of people is large, the impact of the Baltic Power OWF was considered negligible in this case.

6.1.3 Overlapping of construction and exploitation phases

The table (Table 6.13) summarises information on the significance of impacts during the construction and exploitation phases and the significance of these impacts in the case of simultaneous conduct of construction and exploitation phases. It should be noted that although the highest significance of impacts from the construction and exploitation phases adopted in the assessment was assumed for the overlapping construction and exploitation phases, often, the intensity of impacts will not reach the maximum values, understood as the sum of intensity of impacts from the construction and exploitation phases. For example, during the overlap of construction and exploitation phases, the traffic of vessels and helicopters will be constant because of the performance of construction works and will gradually increase due to maintenance works, proportionally to the percentage of wind power stations handed over for exploitation. When most wind power stations have been installed, it may turn out that the traffic intensity of vessels and helicopters will be at the level occurring during the construction phase, increased by almost all service traffic during the exploitation phase. However, for the majority of the overlapping construction and exploitation phases duration, this intensity will not be close to the sum of the intensity from construction and exploitation phases.

Most types of impacts are local in both phases, and therefore, there will be no possibility of accumulation of impacts between the activities performed for construction and operational processes. This is due to the fact that until the construction of a specific wind power station is completed, this wind power station is not operated. Therefore, it was assumed that the significance of the impact during the overlapping phase of construction and exploitation adopts the higher value of the significance of the impacts during the construction and exploitation phases.

For cases where the impact did not occur in any of the phases, the significance of the impact was assumed for the phase in which the impact was present.

Table 6.13. Impact assessment for the construction and exploitation phases and for the overlap of construction and exploitation phases [Source: internal materials]

Receptor	Significance of the Baltic Power OWF impact		
	Construction phase	Exploitation phase	Overlap of construction and exploitation phases
Seabed	Negligible	Negligible	Negligible
Wave motion and sea currents	None	Negligible	Negligible
Sea water	Low	Moderate	Moderate
Seabed sediments	Low	Moderate	Moderate
Climate	Negligible	Negligible	Negligible
Systems using EMF	None	Negligible	Negligible
Phytobenthos	None	Negligible	Negligible
Macrozoobenthos	Low	Moderate	Moderate
Ichthyofauna	Moderate	Negligible	Moderate
Marine mammals	Moderate	Moderate	Moderate
Migratory birds	Low	Moderate	Moderate
Seabirds	Significant	Significant	Significant
Bats	Negligible	Low	Low
Wildlife corridors	Negligible	Negligible	Negligible
Biodiversity	Low	Significant	Significant
Cultural values, monuments and archaeological sites and objects	None	None	None
Use and management of the water area and tangible property	Low	Low	Low
Landscape	Negligible	Negligible	Negligible
Population	Moderate	Negligible	Moderate

6.1.4 Decommissioning phase

6.1.4.1 Impact on geological structure, seabed sediments, access to raw materials and deposits

Impacts occurring during the closure and decommissioning phase of the project will be similar to the impacts present during the construction phase, but they will be less intense. The extent of interference in the seabed will not be as major as in the case of driving foundation piles or support structures. Part of structural elements may be left on and in the seabed. Transmission cables may be completely or only partially removed or left in the seabed.

Changes within the seabed associated with the project impact will be local and negligible for the overall character of the seabed and its structure within the entire area occupied by the project.

Depending on its structure, the seabed may exhibit different sensitivity to the impact of the project during its closure and decommissioning phase. The seabed composed of till and till with a stony cover is difficult to wash out and withstands morphological changes. A sandy, sandy and silty, and silty seabed is more susceptible to the washout and material displacement over it, e.g. in the form of sand waves. Thus, the elements of the OWF infrastructure left in the seabed may be uncovered or buried as a result of both the natural processes transporting rock material over the seabed and as a result of this transport being disturbed by the remaining components of the OWF infrastructure and changes in the seabed relief resulting from the removal of the OWF infrastructure components.

Activities connected with the project closure and decommissioning phase may cause the following types of impacts on the seabed:

- local changes in the seabed relief related to the removal of infrastructure components (cables, components of foundations or support structures of the OWF), cavities in the seabed made at places of anchoring of the vessels decommissioning the OWF.

No changes are planned in the structure of the seabed during the closure and decommissioning phase.

The overall impact of the project during the closure and decommissioning phase can be preliminarily assessed as negligible.

6.1.4.2 Impact on seawater and seabed sediments quality

During the decommissioning phase, most of the OWF facilities will most likely be removed from the seabed, in accordance with international regulations for offshore systems and structures (United Nations Convention on the Law of the Sea – UNCLOS).

These regulations define the conditions for the removal of components and systems of wind farms in the continental shelf areas and the Exclusive Economic Zone. Decommissioning works should be carried out in such a manner that they do not hinder navigation and do not adversely affect the marine environment.

These standards also define exceptional situations in which there is no obligation to remove infrastructure components completely. It is possible to leave such components when:

- the weight of the foundation in the air exceeds 4000 tonnes or it is located at a depth of more than 100 m, provided that it does not hinder the use of maritime areas by other sectors of the economy;
- the removal of the components is technically impossible or too expensive;
- there is a threat to the life of the OWF decommissioning personnel;
- decommissioning involves an unacceptable risk of polluting the marine environment.

In certain locations, such as straits or archipelago waters, used for international navigation, it is necessary to completely remove the systems and structures of the facilities, without any exceptions.

If some components are left on the seabed, relevant surveys should be carried out to determine whether the remnants of the OWF will not interfere with vessel traffic and will not have a negative impact on biotic and abiotic elements of the environment. It should be ensured that the parts of a structure left behind will not start to relocate under the influence of waves, tides, currents or storm surges, causing a hazard to maritime navigation.

During the Baltic Power OWF decommissioning, identical impacts on the receptors discussed (water and seabed sediments) are expected to occur as during the OWF construction phase.

Release of pollutants and nutrients from sediments into water

As a result of the disturbance of seabed sediments during the OWF decommissioning, pollutants and nutrients may be released.

During the extraction of foundations or support structures and cables from the seabed, the impact on the quality of water and sediments will be similar to that from the phase of embedding the foundation or support structures in the seabed during the construction phase. If foundations or support structures remain in the seabed sediments, the impact on the quality of sediments and water will be negligible.

The release of pollutants and nutrients from the sediment into the water during the decommissioning phase has a direct negative impact of regional range, which is short-term, reversible, repeatable, and of medium to large intensity, depending on the location.

The significance of this impact during the decommissioning phase in the APV was assessed to be low for the quality of sea waters and negligible for seabed sediments.

Contamination of water and seabed sediments with oil derivatives during normal operation of vessels and in case of a breakdown

As a result of intense traffic of ships and vessels during the OWF decommissioning, small oil spills and breakdowns or collisions may occur.

Contamination of sea waters or seabed sediments with oil derivatives released during normal operation of vessels is a direct negative impact of local range, temporary or short-term, reversible, repeatable, and of low intensity.

The significance of this impact during the decommissioning phase in the APV was assessed as negligible for the quality of sea waters and seabed sediments.

Contamination of water or seabed sediments with oil derivatives released in an accident is a direct negative impact of regional range, which is short-term, reversible, repeatable, and of high intensity.

The significance of this impact at the decommissioning phase in the APV due to random and sporadic nature of breakdowns and collisions was assessed as low or moderate for the quality of sea waters and seabed sediments.

Contamination of water and seabed sediments with anti-fouling agents

Contamination of water or seabed sediments with anti-fouling substances during the decommissioning phase is a direct negative impact of local or regional range, which is short-term, reversible, repeatable during the construction period, and of low intensity.

The significance of this impact during the decommissioning phase in the APV was assessed as negligible for the quality of sea waters and seabed sediments.

Contamination of water and seabed sediments by accidental release of municipal waste or domestic sewage

Contamination of water or seabed sediments with municipal waste or domestic sewage is a direct, negative impact of local range, which is short-term or momentary, reversible, repeatable during the decommissioning period, and of low intensity.

The significance of this impact during the decommissioning phase in the APV was assessed as negligible for the quality of sea waters and seabed sediments.

Contamination of water and seabed sediments with accidentally released chemicals and waste from the offshore wind farm decommissioning

During the OWF decommissioning, it seems inevitable that water and seabed sediments will become contaminated with waste from the process. The size of this impact will depend on the method adopted for carrying out these works (ref. description of the decommissioning phase), and the greatest pollution may occur in the case of the necessity to crush the GBS.

Waste should be neutralised in accordance with the applicable regulations concerning industrial waste.

Contamination of water or seabed sediments related to the process of OWF decommissioning is a direct, negative impact of local range, which is short-term or momentary, non-reversible, repeatable during the construction period, and of moderate intensity.

The significance of this impact at the decommissioning phase in the APV was assessed as negligible for the quality of sea waters and as low for seabed sediments.

6.1.4.3 Impact on climate, including greenhouse gas emissions and impacts relevant in terms of climate change adaptation and impact on the air (state of the air)

Due to the significant distance of the Baltic Power OWF Area from land, it should be assumed that the planned project in the decommissioning phase will not affect the climate and the air quality. Because the emission generated during the OWF decommissioning will be minimal (coming mainly from the vessels performing dismantling works), it can be assumed that there will be no emission of particulate pollutants and a slight emission of gaseous pollutants, therefore it is not expected for the situation to change.

During the decommissioning phase, there may be a slight increase in greenhouse gas emissions as a result of fuel combustion by vessels handling the dismantling of wind power stations.

During the decommissioning phase, the significance of the planned project impact on climate and the emission of greenhouse gases will be negligible, as there will be no factors that could have a noticeable impact on its change.

The impact of the planned project on the air quality in the decommissioning phase will be temporary and will disappear after the works are completed. Furthermore, since the area is open and unobstructed, pollutant concentrations will decrease rapidly. Therefore, the significance of the impact on the air quality will be negligible.

6.1.4.4 Impact on systems using EMF

The significance of the Baltic Power OWF impact on systems using the EMF, such as radar, communication and radiolocation systems, will be negligible in the decommissioning phase.

6.1.4.5 Impact on nature and protected areas

6.1.4.5.1 Impact on biotic elements in the marine area

6.1.4.5.1.1 Phytobenthos

The decommissioning phase may involve the removal of support structures of wind power stations and the accompanying infrastructure from the maritime area. In such a case, the macroalgae growing on the structures in the euphotic zone will also be removed, so the original conditions from before the project implementation will be restored. Restoration of natural conditions is theoretically a positive phenomenon, however, it should be remembered that structural elements overgrown with organisms of flora and fauna will constitute the so-called artificial reef, which locally increases biodiversity and attracts numerous species of nekton fauna. The dismantling of structural elements of the OWF will, thus, result in the loss of the habitat of anthropogenic origin, but significantly shaping the functioning of the local marine ecosystem. Taking into account the fact that the artificial factor will cause a local and relatively long (the wind farm exploitation period may amount to several dozen years) increase in biotic qualitative (taxonomic composition) and quantitative (abundance and biomass) resources of phytobenthos, it should be considered that its removal, despite its unnatural origin, will have a negative impact on the environment of the marine area in the region of the planned OWF.

In conclusion, the significance of the impact was considered negative and negligible.

6.1.4.5.1.2 Macrozoobenthos

During the phase of closure and decommissioning of the Baltic Power OWF, the following impacts on macrozoobenthos are expected to occur:

- disturbance of the seabed sediment structure;
- short-term increase in suspended solids concentration in water;
- sedimentation of suspended solids on the seabed;
- redistribution of pollutants from sediment into water;
- removal of artificial substrates of underwater wind power station systems from the marine environment.

The assessment of the impact of wind power stations in the OWF Area (1 NM) during the decommissioning phase was carried out separately for:

- soft bottom macrozoobenthos;
- hard bottom macrozoobenthos.

These two complexes of benthic fauna differ in taxonomic composition, abundance and biomass of their constituent species. Therefore, they differ in sensitivity and importance of the group of organisms assessed. The sensitivity of zoobenthos depends on the type of impact and the preferences resulting from the very biology of the species concerned. On the one hand, it is the ability of the population to adapt to various changes occurring in the environment as a result of the implementation of the project and, on the other hand, the ability of a complex of organisms to reconstruct the quantitative structure after the impact factor ceases to exist.

During the closure and decommissioning of the Baltic Power OWF, impacts similar to those from the construction phase (subsection 6.1.1.4.1.2) will occur. This assessment assumes that most OWF facilities will be removed from the seabed in their entirety.

As a result of the removal of foundations or support structures and cables, as well as during operation of jack-up units, **the structure of seabed sediments** will be disturbed. This will cause physical destruction of the benthic organisms which, during the OWF exploitation, recolonised the seabed in the vicinity of foundations or support structures and along the route of cables [224, 471 36]. Due to low sensitivity of the soft bottom macrozoobenthos and moderate sensitivity of the hard bottom macrozoobenthos to this impact, it is assumed that full regeneration of habitats in the place of the removed facilities may take up to several years from the moment of the impact factor cessation. This process is faster for polychaetes and longer for bivalves. After this time, it is expected that a stabilised quantitative structure of the macrozoobenthos complex characteristic for the Baltic Power OWF Area will be achieved. In the case of a soft bottom macrozoobenthos complex which is going to be destroyed, this impact should be considered as negligible. However, for the hard bottom macrozoobenthos complex, this impact is low.

The increase of suspended solids content in water will occur as a result of disturbing the structure of seabed sediments during dredging works related to disassembly of foundations or support structures and cables during which suspended solids rise from the seabed and disperse in the water [249, 471]. However, it should be assumed that the dismantling works are carried out in stages and have a slightly smaller intensity than during the construction. Therefore, the range and intensity of suspended solids dispersion may also be slightly lower than during the construction phase. The most negative effect of this impact is clogging of the filtering systems of filtering macrozoobenthos representatives. However, the significance of this impact will be negligible for the soft bottom macrozoobenthos complex and low for the hard bottom macrozoobenthos.

The negative nature of **sedimentation of suspended solids** on the seabed is related to covering benthic organisms with an additional layer of sediment [471]. The epifauna, i.e. the fraction of macrozoobenthos living on the sediment surface, is at particular risk. The results of the model calculations of suspended solids dispersion in the Baltic Power OWF Area included in Appendix 2 to the EIA Report indicate that the average thickness of sediments in the entire area of the Baltic Power OWF deposited as a result of the works conducted may not exceed 1.4 mm and due to the local nature of this impact, the entire benthic association will be subject only to short-term exposure to unfavourable conditions. Similarly as in the case of other impacts, the impact of suspended solids sedimentation on the seabed on the soft bottom macrozoobenthos was assessed as negligible, whereas for the hard bottom macrozoobenthos as low.

During the OWF decommissioning phase**, redistribution of pollutants from sediments to water may** occur again, and the intensity of the negative impact on macrozoobenthos will depend on the level of concentration of heavy metals and persistent organic pollutants identified in the seabed sediments of the OWF Area (1 NM). According to the results of geochemical surveys included in Appendix 1 to the EIA Report, this impact, of negligible significance, will not cause significant changes in the physiology of the soft bottom macrozoobenthos inhabiting the OWF Area (1 NM) nor the hard bottom macrozoobenthos (low impact significance).

Removal of artificial underwater substrates of the wind power station systems from the marine environment will result in irreversible, permanent elimination of the periphyton compexes of the "artificial reef" and destruction of benthos around each foundation or support structure and the restructuring of the qualitative and quantitative structure of the macrozoobenthos complex created as a result of several dozen years of the OWF exploitation. At the current state of knowledge, it is difficult to clearly predict how quickly the environment will return to the state from before the impact of the factor and what nature of this impact (negative or positive) will prevail. The process of closure of the OWFs built in Europe has only started and so far only 4 OWFs have been decommissioned (2 in Sweden, the first of which was closed in 2015, 1 in Denmark and 1 in the Netherlands), with particular attention paid to the cost of such investment and the recovery of steel, and not to environmental monitoring [420]. It is known that in connection with the removal of artificial substrates, biodiversity will be reduced and the local reduction in the resources of macrozoobenthos, which is an additional food supply for fish and seabirds, will occur. On the other hand, the original natural status of seabed habitats in the OWF Area will be restored, which is a positive action. The analysis of pressure factors demonstrated that the significance of the impact of removing artificial reef with moderate importance of the resource was assessed as moderate.

6.1.4.5.1.3 Ichthyofauna

The impact analysis is hindered by the lack of experience in decommissioning, as well as the lack of possibility to predict which technologies will be available in twenty years or so, when the OWF will be disassembles [311]. The list and nature of the impacts related to the decommissioning of the project should be similar to those occurring during the exploitation phase.

Emission of noise and vibration

The source of noise will be the works related to the removal of OWPS structures and the increased traffic of vessels. The intensity of the impact depends, to a large extent, on the propagation of sound, depending on the seabed morphology, as well as the distance between the receptor and the noise source. The lethal effect may occur up to several dozen meters [453], whereas the damage to hearing and tissues may occur up to several hundred metres [298] from the sound source. The avoidance reaction may appear even at a distance of several dozens of kilometres, extending beyond the Baltic Power OWF Area. The effects of the impact on ichthyofauna are similar to those occurring during the exploitation phase. According to Wilhelmsson *et al.* [453] detonation or cutting noise can cause death or severe injury to the fish present nearby (negative effect). Therefore, it is necessary to avoid blasting of structural elements as the most harmful method. The aforementioned lack of experience makes it difficult to assess the risks posed by the impact related to the removal of structural elements from the environment. However, it seems that the time needed for their disassembly will be shorter than the time of their construction, which in combination with a possible reduction of the intensity of works in the spawning season should limit any impact.

Moreover, it should be remembered that the OWF Area is not a spawning ground of the cod or the deep-water spawning European flounder dominant in this area. During ichthyofauna surveys the sprat spawning was found, but this sea area is small in comparison with the large areas of the spawning grounds of pelagic fish. Herring spawning may occur in the OWF Area, but it may be assumed that any disturbances in the reproductive process will not affect the recruitment of this species at the population level.

Emission of noise and vibrations generated during the removal of the OWF foundation piles may directly affect the ichthyofauna. These will be negative, direct, short-term, and regional impacts.

The sensitivity to the impact was assessed as very high for the cod, sprat, and herring, and as high for the flounder, sand goby, and the common seasnail. The significance of the impact is assessed as low for all the fish species examined. In the case of the fish under protection, only larval stages occurred during the survey, for which the impact will be local.

Increase in suspended solids content

During the works related to the dismantling of the infrastructure components, sediments will be disturbed and water turbidity will occur. The sensitivity of the ichthyofauna depends on the species and the stages of life. The impact magnitude depends on the concentration of suspended solids, exposure time and the nature of suspended solids particles. Covering of eggs, change in buoyancy of eggs, obstruction to gaseous exchange, obstruction to the process of respiration, visibility change, depending on the species and developmental stage, may result in increased susceptibility to predation or feeding efficiency, the decrease of the growth rate, disruption in physiology and avoidance reaction (negative/positive effect). This applies to relatively small areas in relation to the entire surface area of the spawning and feeding grounds.

The OWF Area is neither a spawning ground of the cod nor of the deep-water spawning European flounder dominant in this area. During ichthyofauna surveys the sprat spawning was found, but this sea area is small in comparison with the large areas of the spawning grounds of pelagic fish. Herring spawning may occur in the OWF Area, but it may be assumed that any disturbances in the reproductive process will not affect the recruitment of this species at the population level.

The impact related to the increase of suspended solids content will be negative, direct, local, and short-term.

The sensitivity to the impact was assessed as high for the sprat and herring, and moderate for the codfish, European flounder, sand goby, and the common seasnail.

The significance of the impact is assessed to be negligible for all the fish species examined.

Release of pollutants and nutrients from sediments

During the dismantling works, the sediments will be disturbed and pollutants (i.a. heavy metals, chlorinated biphenyls, pesticides, oil derivatives) and nutrients will be released from sediments into water.

Exposure of ichthyofauna to an increased concentration of pollutants and nutrients may cause increased mortality and diseases (e.g. skin disease, liver and gill damage). Wilhelmsson *et al.* [453] assess the risk of adverse effects as small and spatially limited.

However, the risk of releasing larger amounts of harmful chemical substances from sediments (according to the HELCOM classification) is low, due to their low concentrations found in the sediments of the Southern Baltic, confirmed by the results of surveys carried out for the project (Appendix 1). Low concentrations of pollutants were found in the survey results, often below the lower limit of quantification.

The impact related to releasing pollutants and nutrients from sediments into water will be negative, direct, local, and short-term.

The sensitivity to the impact was assessed as moderate for all the fish species examined. The significance of the impact is assessed to be negligible for all the fish species examined.

Habitat change

During the OWF decommissioning, a significant part of the artificial reef is destroyed, which provides the places of living, feeding, shelter and reproduction for many fish species. This may result in a decrease in the abundance and diversity of ichthyofauna. This negative effect may be partially limited by leaving anti-erosion protections on the seabed, which are an important element of the habitat created during the exploitation phase. Decommissioning of the OWF infrastructure will enable fishing in this area. This may reduce the beneficial impact on ichthyofauna of the fishing activities cessation, in particular on the reproduction processes of certain fish species (the common seasnail, gobies).

The OWF Area is neither a spawning ground of the cod nor of the deep-water spawning European flounder dominant in this area. During ichthyofauna surveys the sprat spawning was found, but this sea area is small in comparison with the large areas of the spawning grounds of pelagic fish. Herring spawning may occur in the OWF Area, but it may be assumed that any disturbances in the reproductive process will not affect the recruitment of this species at the population level.

The impact related to the change of habitat will be negative, direct, local, long-term and permanent.

The sensitivity to the impact was assessed as high for all the fish species examined. The significance of the impact is assessed to be negligible for all the fish species examined.

6.1.4.5.1.4 Marine mammals

In general, the decommissioning process will take place in a reverse sequence compared to the OWF installation procedure, which means that many activities present in the decommissioning phase will be similar to those in the construction phase. However, neither piling nor the use of explosives will be required. The removal of large-diameter monopiles from the Baltic Power OWF Area may include the following activities, which may generate underwater noise:

- mobilising a floating crane, a transport pontoon with a tugboat and a working vessel;
- connecting a hook to the transition piece of the large-diameter monopile foundation;
- cutting of cables;

- removing soil from the foundation or support structure up to the cutting height;
- cutting, cutting out or burning off the large-diameter monopile with an appropriate cutting tool at an appropriate height;
- lifting the large-diameter monopile;
- placing the large-diameter monopile on the pontoon and mounting it or applying other technology allowing to ensure buoyancy of the discarded element and tugging it away to the place of disposal;
- transporting ashore,
- recycling and disposal of materials.

Given the list above, the most probable noise generating activities to be assessed are vessel traffic (to and from the area and during decommissioning works) as well as cutting and drilling (soil removal process). There is no data on noise emissions during cutting. Therefore, the focus was on noise from vessel traffic and drilling from rigs.

Drilling noise largely depends on the rig used for drilling. Drilling vessels generate the highest noise level [241, 349], while noise from drilling rigs anchored to the seabed, such as jack-up rigs, is likely to be low both in terms of noise source level and low frequencies [118]. Kyhn *et al.* [241] recorded noise from the Stena Forth drilling vessel in Baffin Bay in Greenland. The broadband noise recorded amounted to 184 dB re 1µ Pa rms during drilling and 190 dB re 1µ Pa rms during maintenance. Noise from two drilling vessels is shown in the figure below (Figure 6.3). The spectral energy of noise was mainly below 1 kHz, and its impact on the local acoustic background was largely related to low frequency sound. Kyhn *et al.*, however [241], found increased noise levels and peaks at frequencies above 10 kHz, but they were highly correlated with the performance and use of on-board machinery [349]. In the Baltic Sea, drilling noise will increase the local acoustic field, which is already dominated by the noise generated by vessels.

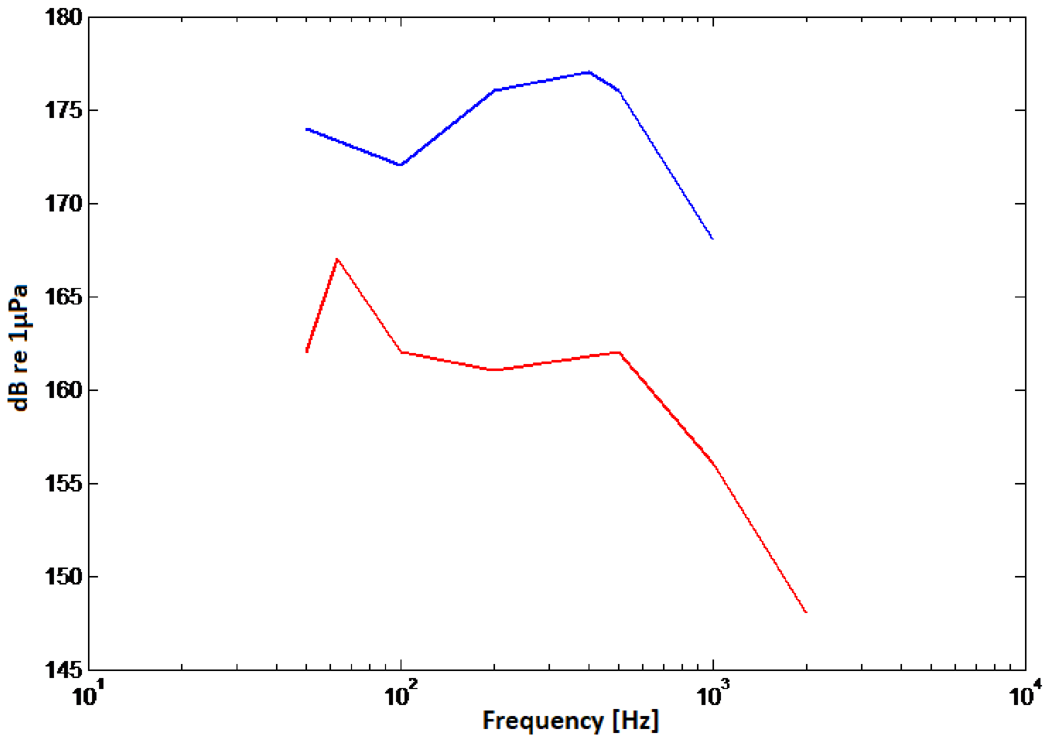


Figure 6.3. Noise levels from two different drilling vessels in 1/3 octave bands. Modified after Richardson et al. [349] [Source: internal materials]

Similarly to the construction phase, during the decommissioning phase of the wind farm, noise from small and medium-sized vessels will be present (mainly noise of 160–180 dB re 1 µPa at a distance of 1 m, covering frequencies from < of 1 kHz to > 10 kHz). It is likely to lead to an increase in the local sound field during dismantling, including frequencies that are partially significant for marine mammals.

Removal of large-diameter monopiles will involve such activities as cutting, burning off, drilling, and vessel traffic. Apart from cutting, for which noise levels are unknown, the latter two actions will only temporarily and locally increase the low frequency levels of the existing background noise in the Baltic Power OWF Area. However, the impact on the sound field would still be local and short-term. As a consequence, the significance of the sound field emitted during the wind farm decommissioning was assessed to be low or moderate (Table 6.14). As mentioned above, ship collisions leading to oil spills in the project area may have a negative impact on marine mammals present in the adjacent waters. However, oil spills are very unlikely.

Table 6.14. Impacts on marine mammals related to activities in the decommissioning phase [Source: internal materials]

Species	**Impact**	**Impact description**	**Impact significance**
Harbour porpoise *Phocoena phocoena*	Shipping noise	Behavioural response to shipping noise (moving away from the decommissioning site)	Low
	Drilling	Behavioural response to drilling noise (moving away from the decommissioning site)	Low
	Vessel collisions	Contamination caused by collision of vessels used for decommissioning (e.g. fuel spillage)	Moderate

Species	Impact	Impact description	Impact significance
Grey seal *Halichoerus grypus*	Shipping noise	Behavioural response to shipping noise (moving away from the decommissioning site)	Low
	Drilling	Behavioural response to drilling noise (moving away from the decommissioning site)	Low
	Vessel collisions	Contamination caused by collision of vessels used for decommissioning (e.g. fuel spillage)	Moderate
Harbour seal *Phoca vitulina*	Shipping noise	Behavioural response to shipping noise (moving away from the decommissioning site)	Low
	Drilling	Behavioural response to drilling noise (moving away from the decommissioning site)	Low
	Vessel collisions	Contamination caused by collision of vessels used for decommissioning (e.g. fuel spillage)	Low

The significance of the impact in the decommissioning phase was assessed as moderate at the most.

6.1.4.5.1.5 Migratory birds

With the commencement of works related to the decommissioning of the Baltic Power OWF, the space will gradually be cleared of structural elements. Therefore, the same impacts on migratory birds that occurred during the exploitation phase, i.e. the barrier effect and collision with the OWF structures, will be reduced until their complete cessation, after removal of the last structural member of the OWF from the area. Detailed assessment of the impact of the Baltic Power OWF during the decommissioning phase on migratory birds is included in Appendix 4 to the EIA Report.

The significance of the impact of the Baltic Power OWF, i.e. the barrier effect and collision probability, on migratory birds during the decommissioning phase was assessed to be low at the most.

6.1.4.5.1.6 Seabirds

Identification of potential impacts on seabirds during the decommissioning phase

The impact of the OWF on marine avifauna during the decommissioning phase will be similar as in the construction phase of the planned project. It was assumed that the medium-term impact of the project in the construction and decommissioning phases will be similar in the case of vessel traffic, increased noise level, lighting of the dismantling site and disturbances in benthic communities. The specific impact of the decommissioning phase consists in the gradual disappearance of the tall OWF structures resulting in the disappearance of a barrier blocking access to rich benthic communities that will develop in the OWF Area during its exploitation.

With the gradual removal of wind power station towers, the negative impact manifested through the deterrence of birds from the area occupied by high protruding structures will decrease. Increased traffic of vessels and noise related to the dismantling of the wind farm will still be scaring birds away. However, it should be expected that after the complete removal of all wind power stations, this area will attract diving benthivorous birds (mainly the long-tailed duck and the velvet scoter), because zoobenthos complexes constituting food for these birds will develop on the seabed in the area occupied by wind power stations during the period of OWF exploitation. Benthivorous birds have a very strong impact on the population of their prey, leading to a significant reduction in abundance and biomass [165, 256]. The decrease in the number of birds in the area occupied by wind power stations during their exploitation will cause the zoobenthos biomass to be high, as these populations will not be exploited by the birds as much as if they were normally present in the area. This effect will probably be periodic, although it is difficult to predict how long the area will constitute an attractive feeding ground for this group of birds after the wind farm is decommissioned.

In order to determine the significance of the impact, the range of the impact was assessed as high for the long-tailed duck and velvet scoter, moderate for the razorbill and common guillemot, and insignificant for the European herring gull.

The factors identified and the assessment of their impact on marine avifauna during the decommissioning phase are presented below.

Vessel traffic

Demolition works will require the presence of various types of vessels that will disturb seabirds because of physical presence, noise and light emission. The range of the impact will be similar as during the project construction phase. This impact will gradually decrease with the progress of dismantling works.

For all the species assessed, vessel traffic constitutes a negative impact and is accumulating. For the long-tailed duck, common guillemot, European herring gull and velvet scoter, this is a direct and medium-term impact, while for the long-tailed duck it is assessed as temporary or short-term. Apart from the European herring gull, for which sensitivity was assessed as low, birds are highly sensitive to vessel traffic.

The significance of the impact varies for individual species and is assessed as negligible for the European herring gull, moderate for the razorbill and common guillemot, and high for both duck species, the long-tailed duck and the velvet scoter.

Emission of noise and vibration

The presence and traffic of construction vessels during dismantling works will be the main cause of disturbance of seabirds in the area covered by the construction of the Baltic Power OWF. This impact will be much higher than other pressures related to the construction phase, such as underwater noise emission. Noise and vibration during the decommissioning phase are direct negative impacts on seabirds of local range (regional for the long-tailed duck, due to possible impact on the biogeographical population of the species), medium-term, reversible, repeatable during the decommissioning period, with intensity depending on the species.

Sensitivity to the impact was assessed as low for the European herring gull and for other species as high.

The significance of the impact varies for individual species and is assessed as negligible for the European herring gull, moderate for the razorbill and common guillemot, and high for both duck species, the long-tailed duck and the velvet scoter.

This impact will gradually decrease with the progress of dismantling works.

Lighting of the project site

When migrating, birds navigate according to natural light sources such as stars and the sun. It has been noticed that at night they also head towards lighthouses, oil rigs and other structures illuminated by artificial light [451]. Lighting of the project site during the decommissioning phase will cause direct negative impact on seabirds of local range (regional for the long-tailed duck, due to possible impact on the biogeographical population of this species), medium-term, reversible, repeatable during the decommissioning period, with intensity depending on the species.

Sensitivity to the impact was assessed as low for the European herring gull and for other species as high.

The significance of the impact varies for individual species and is assessed as negligible for the European herring gull, moderate for the razorbill and common guillemot, and high for both duck species, the long-tailed duck and the velvet scoter.

This impact will gradually decrease with the progress of dismantling works.

Barrier creation

Civil engineering structures and the presence of vessels necessary to handle the OWF dismantling works will be a source of direct negative impacts on seabirds, of local range, reversible, repeatable during the decommissioning period, with intensity depending on the species.

Sensitivity to the impact was assessed as low for the European herring gull and for other species as high.

The significance of the impact varies for individual species and is assessed as negligible for the European herring gull, moderate for the razorbill and common guillemot, and high for both duck species, the long-tailed duck and the velvet scoter.

This impact will gradually decrease with the progress of dismantling works.

Collisions with vessels

During the decommissioning phase of the planned project, collisions of seabirds with vessels may occur. The range of the impact will be similar as during the project construction phase. For all species assessed, collisions with vessels are negative impacts and are subject to accumulation. For the razorbill, common guillemot, European herring gull and velvet scoter, it is a temporary or short-term impact and for the long-tailed duck it is assessed as permanent or long-term.

Sensitivity to the impact was assessed as low for the European herring gull and for other species as high.

The significance of the impact varies for individual species and is assessed as negligible for the European herring gull, moderate for the razorbill and common guillemot, and high for both duck species, the long-tailed duck and the velvet scoter.

This impact will gradually decrease with the progress of dismantling works.

Destruction of benthic habitats

The analysis of the EIA Report shows that the destruction of benthos habitats during dismantling works is an indirect negative, local-range, medium-term, reversible, repeatable impact on seabirds (mainly benthivorous species) during the decommissioning period (for each wind power station or infrastructure component), with intensity depending on the species. The range of impact will mainly depend on the number of foundations or support structures of wind power stations, their type and size.

Sensitivity to the impact was assessed as insignificant for the European herring gull, for the razorbill and common guillemot as moderate, and for the long-tailed duck and velvet scoter as high.

The significance of the impact varies for individual species and is assessed as negligible for the European herring gull, low for the razorbill and common guillemot, and as high for both duck species, the long-tailed duck and the velvet scoter.

This impact will gradually decrease with the progress of demolition works and the damaged habitats will be restored within a few years after the completion of works.

Increased concentration of suspended solids in water

These factors may affect the ability of diving benthivorous and piscivorous species to obtain food. During the OWF construction, seabed sediments will be disturbed and the concentration of suspended solids in water will increase. The range of the impact will be similar as during the project construction phase.

For all bird species assessed, it constitutes a negative impact subject to accumulation. For the razorbill, common guillemot, European herring gull and velvet scoter, this is a temporary or short-term impact, and for the long-tailed duck, it is assessed as long-term or permanent.

Sensitivity to the impact was assessed as insignificant for the European herring gull, for the razorbill and common guillemot as moderate, and for the long-tailed duck and velvet scoter as high.

The significance of the impact varies for individual species and is assessed as negligible for the European herring gull, low for the razorbill and common guillemot, and as high for both duck species – the long-tailed duck and the velvet scoter.

This impact will gradually decrease with the progress of dismantling works.

Sedimentation of disturbed sediments

These factors may affect the ability of diving benthivorous and piscivorous birds to obtain food. During the OWF decommissioning, seabed sediments will be disturbed and the concentration of suspended solids in water will increase. The range of the impact will be similar as during the project construction phase.

For all bird species assessed, this is a secondary, negative impact, subject to accumulation. For the long-tailed duck, common guillemot, European herring gull and velvet scoter, this is a medium-term impact, and for the long-tailed duck, it is assessed as long-term or permanent.

The European herring gull sensitivity to impact was assessed as insignificant, the razorbill and common guillemot as moderate, and the long-tailed duck and velvet scoter as high.

The significance of the impact varies for individual species and is assessed as negligible for the European herring gull, low for the razorbill and common guillemot, and as high for both duck species – the long-tailed duck and the velvet scoter.

This impact will gradually decrease with the progress of dismantling works..

The table (Table 6.15) presents a summary of the significance of impacts of the Baltic Power OWF on seabirds during the decommissioning phase.

Table 6.15. Significance of the project impact on seabirds during the decommissioning phase

Species	Impact significance
European herring gull *Larus argentatus*	Negligible
Razorbill *Alca torda,* Common guillemot *Uria aalge*	Moderate
Velvet scoter *Melanitta fusca*	High
Long-tailed duck *Clangula hyemalis*	High

6.1.4.5.1.7 Bats

The decommissioning phase will include activities similar to those of the construction phase. Therefore, it can be assumed that the impacts in the decommissioning phase will also be similar to those listed in the construction phase. The following activities during the decommissioning phase may affect migratory bats:

- removal of OWF elements;
- the presence of vessels;
- dismantling works under and above the sea surface.

Removal of OWF elements and related vessel traffic will lead to an increase in noise. Bats may be scared by noise, which may also act as a barrier. Lighting systems on ships and dismantling locations may attract bats [329]. This may lead to a risk of collision with vessels and structures intended for removal. The vessels and OWF elements to be removed may serve as resting sites for migratory bats [2].

Surveys conducted in the spring and autumn migration seasons indicated a possibility of bats migrating in the OWF Area. However, migration intensity was low due to the low activity of bats.

Impacts on bats during the decommissioning phase will be negative, direct, local and short-term.

Sensitivity to the impact was assessed as low, whereas the significance of the impact of the Baltic Power OWF at the decommissioning stage was considered negligible due to the low activity of bats found during the surveys in the period of seasonal migrations.

6.1.4.5.2 Impact on protected areas

6.1.4.5.2.1 Impact on protected areas other than Natura 2000

Given the location of the Baltic Power OWF at a significant distance from the protected area of the Słowiński National Park, there will be no significant impact on this area or on any of the elements for which it was established, such as biodiversity, resources, objects and elements of inanimate nature and the landscape of the park.

In the Appendix to the Ordinance of the Minister of the Environment of 16 February 2017 on the protection tasks of the Słowiński National Park (Official Journal of the Ministry of the Environment of 2017, item 10, as amended), in which the existing and potential internal and external threats and methods of elimination or mitigation of these threats and their effects were identified and assessed, the existing external threats category indicates the risk resulting from increasing the areas for wind farm construction in the municipalities adjacent to the Park. In the category of potential external threats, only the construction of wind farms in the buffer zone of the Park was indicated as constituting a potential external threat and therefore it should be stated that the Baltic Power OWF will not pose a threat to the Słowiński National Park.

6.1.4.5.2.2 Impact on Natura 2000 sites

The identification and assessment of impacts on protected areas within the European Natura 2000 network is presented in subsection 6.3.

6.1.4.5.3 Impact on wildlife corridors

The subject of wildlife corridors in maritime areas is described in subsection 6.1.1.4.3.

With respect to seabirds, the impact of the OWF decommissioning process on wildlife corridors will have an effect contrary to that of the construction phase. As individual structural elements are removed from the space, the possibility of free migration of birds will increase.

6.1.4.5.4 Impact on biodiversity

Phytobenthos and macrozoobenthos

With the removal of artificial substrates, the plant and animal periphyton communities present on these structures will be destroyed, (habitat and taxonomic) biodiversity will decrease and the resources of macrozoobenthos constituting food for fish and seabirds will decrease locally. On the other hand, the original natural status of seabed habitats in the OWF area will be restored.

Ichthyofauna

Works related to wind farm decommissioning may have a negative impact on species diversity, and the nature of this impact should be similar to the one observed during the construction. After the decommissioning phase, the ichthyocenosis can be expected to return to the original state.

Marine mammals

It is unlikely that the decommissioning phase will have a negative impact on the biodiversity of marine mammals in the area surveyed and adjacent waters.

Seabirds

The analysis of the possible impacts resulting from the dismantling activities performed at the OWF decommissioning stage shows that their effects will in most cases be short-term, local and reversible. This applies to all types of emissions (noise, suspended solids, release of nutrients from seabed sediments). The intensity of environmental impact will decrease as the distance from their source increases. Mobile species (fish, marine mammals, birds) will avoid spaces in which they find their optimum conditions to deteriorate. As the deterring effect for these species is limited in time while the marine environment is extensive, the species (fish, marine mammals) will return to the area from which they were scared or will use the adjacent areas after the emissions cease and the living conditions are back to what they were before. Dismantling works will result in restoration of the original conditions in the habitat which are changed as a result of the OWF construction. Therefore, it is expected that the structure of the zoobenthos will be renewed in terms of its quality and quantity to achieve the pre-investment condition.

AS a result of project implementation, the sea habitat will not be fragmented in a manner resulting in the isolation of populations permanently or temporarily related to the Baltic Power OWF Area and adjacent areas.

There will also be no direct or indirect destruction of benthic and pelagic habitats following the construction works performed which could, as a consequence, lead to the extinction of resident species. As a result of the works performed, no physical barriers will be created which marine organisms could not overcome.

Considering the above, it can be stated that the decommissioning phase of the OWF may lead to a short-term change in the number of species present in the development area. Individual species may be temporarily scared off to the adjacent areas where they will not be exposed to disturbances. However, such a movement of individuals does not mean a change of biodiversity at the species level. Moreover, the works will also not lead to changes in the level of ecosystem and genetic diversity.

The impact of the project on biodiversity can be considered insignificant.

6.1.4.6 Impact on cultural amenities, monuments and archaeological sites and objects

In the Baltic Power OWF Area, the presence of anthropogenic objects was recorded. As of the date of submission of the EIA Report, there is no confirmation that these structures have cultural values, and they are not entered into the register of monuments. There are no archaeological sites either.

If it is found that anthropogenic objects present in the Baltic Power OWF Area have cultural values or are monuments, the significance of the impact is assessed as negligible. The assessment results from the assumption of designating a zone around such structures in which no activities resulting in disturbance of the seabed will be carried out.

6.1.4.7 Impact on the usage and development of the sea area and on material goods

Currently, the Baltic Power OWF Area is not exploited intensively by other users (i.e. sectors related to fishing, shipping, raw materials) and therefore the release of the area as a result of the OWF decommissioning will be of minor importance for the said purposes. Accordingly, the significance of the impact was assessed as negligible.

6.1.4.8 Impact on landscape, including the cultural landscape

The impact of the OWF on the landscape in the Baltic Power OWF decommissioning phase will be similar to the impacts in the construction phase, but the order will be reversed. First, the structures and systems will be dismantled, then they will be collected by vessels and transported ashore. Impacts on the landscape during this phase will decrease as the decommissioning works progress.

Depending on the foundation technology adopted, it may be necessary to leave parts of the structures under water, e.g. due to the fact that they will form an artificial reef. In this case they will be properly secured and marked for safety reasons. After the completion of OWF decommissioning, the landscape on the sea surface within the OWF Area will return to the condition before project implementation, whereas there may be a permanent change in the underwater landscape, which will be available only to divers or underwater vehicles equipped with cameras for ongoing observation or subsequent restoration. Such places may also become tourist attractions.

The significance of the impact of the Baltic Power OWF on the landscape, including the cultural landscape, at the decommissioning stage is assessed to be negligible.

6.1.4.9 Impact on population, health and living conditions of people

OWF decommissioning in marine conditions will be a very complex, long-term task with increased risk for the vessels disassembling OWPSs and for other users of the water areas. It should be expected that in the period when it will be necessary to decommission the OWF, the intensity of navigation on shipping routes in the OWF area will be much higher than currently, and the number of additional cruises of technical vessels of various sizes, involved in the dismantling of wind power stations and other structures of the Baltic Power OWF, will be close to those involved in the construction, i.e. over 4000 cruises.

At the same time, it should be emphasised that the routes of these additional cruises of technical vessels dedicated to OWF decommissioning, moving between the Baltic Power OWF and small ports of the central coast and ports of the Tricity, will cross the routes of vessels cruising along navigation routes of the Southern Baltic.

Similarly to the construction phase, fishing activities in parts of the fishing squares N7, N8, O7 and O8 will be limited.

Also, emergency response in case of emergency events involving vessels shall be limited to conducting rescue operations or combating oil spills.

The significance of the impact of the Baltic Power OWF during the decommissioning phase on the population, health and living conditions of people was estimated to be negligible, despite the high significance of the resource itself. This results from the fact that, during the decommissioning phase, all users of the sea will be already familiar with the restrictions related to the existence of the Baltic Power OWF, and its gradual decommissioning will only increase the availability of the Baltic Power OWF water area for other forms of use.

6.2 Rational Alternative Variant (RAV)

Descriptions of the Applicant Proposed Variant (APV) and the reasonable alternative variant (RAV) are included in subsection 2.3. The options differ in two key parameters, i.e. the maximum number of wind power stations and the maximum rotor diameter (Table 2.4). These two main parameters of the Baltic Power OWF may generate different environmental impacts.

When assessing the impact on individual elements of the environment in all phases of the project implementation, no differences were found in the significance of the impact between the two options under consideration. There were only differences in modelling results between the APV and the RAV regarding the assessment of collision probability for migratory birds during the exploitation phase. The results of collision modelling showed the same or higher risk of collision of migratory birds for the RAV. However, these higher collision risk levels for the RAV did not increase the significance of the impact. A detailed assessment of the impact of the Baltic Power OWF for the APV and the RAV on migratory birds is included in Appendix No. 4 to the EIA Report.

6.3 Impact assessment on Natura 2000 sites

6.3.1 Initial assessment

The primary objective of protection of Natura 2000 sites is to maintain or restore the proper conservation status of species and natural habitats which are subject to protection and for the protection of which these areas have been designated.

The Baltic Power OWF project is not directly related to or necessary for the management of Natura 2000 sites. Consequently, impact assessment is required for these areas.

Detailed information on Natura 2000 sites located in a direct or further vicinity of the Baltic Power OWF Area is presented in Section 3.

An essential element of the preliminary assessment of the Baltic Power OWF impact on the Natura 2000 sites is to determine whether a given Natura 2000 site is within the range of potential impacts of the Baltic Power OWF. The location of the Baltic Power OWF Area against the background of the location of Natura 2000 sites is presented in the figure (Figure 3.17).

The main premises for concluding whether or not the planned project may impact a Natura 2000 protected area are the distance between this area and the project implementation area and the range of the impacts. Due to the specific nature of the Natura 2000 network and possible functional connections between such areas, the location of the project area in relation to the Natura 2000 sites is also important. The table (Table 6.16) shows distances (understood as distances from the nearest points of both areas) of Natura 2000 areas from the Baltic Power OWF Area and a list of the subjects of protection present in these areas.

Table 6.16. Marine and coastal Natura 2000 sites located closest to the Baltic Power OWF [Source: internal materials]

Area name/code	Distance from the Baltic Power OWF Area[km]	Subjects of protection in the area		
		Marine habitats	Species of marine animals	Bird species
Przybrzeżne wody Bałtyku (PLB990002)	8.96	-	-	**Long-tailed duck (A064)** Common scoter (A065) Velvet scoter (A066) **European herring gull (A184)** Razorbill (A200) **Black guillemot (A202)**
Ostoja Słowińska (PLH220023)	20.19	Rocky seabed, reefs (1170)	Sea lamprey (1095) European river lamprey (1099) Twait shad (1103) Salmon (1106) **Porpoise (1351)** Grey seal (1364) Sichel (2522)	-
Ławica Słupska (PLC990001)	25.50	Submarine sandbanks (1110) Rocky seabed, reefs (1170)	-	**Long-tailed duck (A064)** **Black guillemot (A202)**
Hoburgs bank och Midsjöbankarna (SE0330308)	55.47	Submarine sandbanks (1110) Rocky seabed, reefs (1170)	**Porpoise (1351)**	Common eider (A063) **Long-tailed duck (A064)** **Black guillemot (A202)**

Additionally, the table (Table 6.16) distinguishes the species of birds and other marine animals which are subject to protection in at least two areas. The species identified include the porpoise (1351) and three bird species: the long-tailed duck (A064), the European herring gull (A184) and the black guillemot (A202). Assigning these animal species as subjects of protection to Natura 2000 sites indicates that these areas are important places where they stay and, at the same time, that these species are likely to move between these areas. Taking this into account, it can be assumed that the long-tailed duck and the black guillemot will most likely fly between the following areas: Baltic Coastal Waters Area (Przybrzeżne wody Bałtyku) (PLB990002), Słupsk Bank (Ławica Słupska) (PLC990001) and Hoburgs bank och Midsjöbankarna (SE0330308). In the case of the European herring gull, which is protected in the Coastal waters of the Baltic Sea (PLB990002) and is not a subject of protection in other Natura 2000 sites analysed, a lesser probability of migration of this species between the coastal water zone and the water areas located north of it may be assumed.

The porpoise (1351) is not a migratory species. It uses the area of stay in connection with feeding or reproduction. This area may change but there is no migration between these areas. Therefore, there is little connection between the various Natura 2000 sites that might require an assessment of the impact on the network of links between them[406, 104].

6.3.1.1 Determination of the project impact ranges

The Baltic Power OWF Area is located outside the areas of the European Natura 2000 network (Table 6.16). Therefore, when determining the impact of the planned project on Natura 2000 sites, impacts extending beyond the Baltic Power OWF Area were assumed. Identification and assessment of the impacts on individual elements of the environment are presented in subsections 6.1 and 6.2. The table below (Table 6.17) shows the impacts that may extend beyond the Baltic Power OWF Area and protected elements of Natura 2000 sites that may be affected by these impacts.

Table 6.17. List of impacts and affected elements of Natura 2000 sites

Impact	Element of Natura 2000 sites
Increased concentration of suspended solids in water and its sedimentation	Subjects of protection: fish species and habitats
Underwater noise	Subjects of protection: species of marine mammals and fish
Space disturbance	Subjects of protection: bird species, integrity of the area "Przybrzeżne wody Bałtyku" (PLB990002), network coherence

6.3.1.1.1 Suspended solids and their sedimentation

When determining the impact range of the increase in the suspended solids content in water and the resulting sedimentation, the following assumptions were made:

- the maximum range of the suspended solids with a concentration of 4 mg dm^{-1} is 4.5 km from the place of their generation;
- the maximum range of the suspended solids sedimentation area with a thickness of 1 mm is no greater than 2 km.

The aspects of the impact of the increase in the suspended solids content on biotic elements are described in subsections 6.1 and 6.2. Only in the case of fish eggs and juvenile forms, data from literature are available indicating suspended solids contents at which significant impacts may occur. The values specified therein, from the level of which a significant negative impact on the organisms described occurs, are 10–12 mg dm^{-1}, and already with a suspended solids content of 3–5 mg dm^{-1} avoidance reactions are observed.

Therefore, using a conservative approach, it was assumed that the limit of significant impact is the increase of the suspended solids content to 4 mg dm^{-1}.

The destruction of benthic organisms could indirectly affect the deterioration of the food supply for birds. In order to determine the range of significant impact of suspended solids sedimentation, a conservative value of 1.5 mm of the deposited sediment was used, assuming that dissolved oxygen reaches the depth of 2 mm inside the sediment in the diffusion process [183].

The increase in suspended solids concentration and their sedimentation due to the maximum range of these processes will not affect the habitats of Sublittoral sandbanks (1110) and Reefs (1170) in the Słupsk Bank site (PLC990001) as well as Reefs (1170) in the Ostoja Słowińska site (PLH220032). Changes in the morphology of the seabed will be caused by the work related to the erection of foundations or support structures of the OWF and the activities related to laying of cables within the Baltic Power OWF Area. They will be local and limited to the places where these activities are carried out. Taking into account the distance of the nearest structures of the Baltic Power OWF from the boundaries of the aforementioned habitats and the maximum range of suspended solids sedimentation, the boundaries of the habitat will not change. For the same reason, i.e. a significant distance of the protected habitats (receptors) from the source of impact, the increase in suspended solids content and their sedimentation will not result in fragmentation of these habitats, nor will it affect their structure and function (Figure 6.4, Figure 6.5).

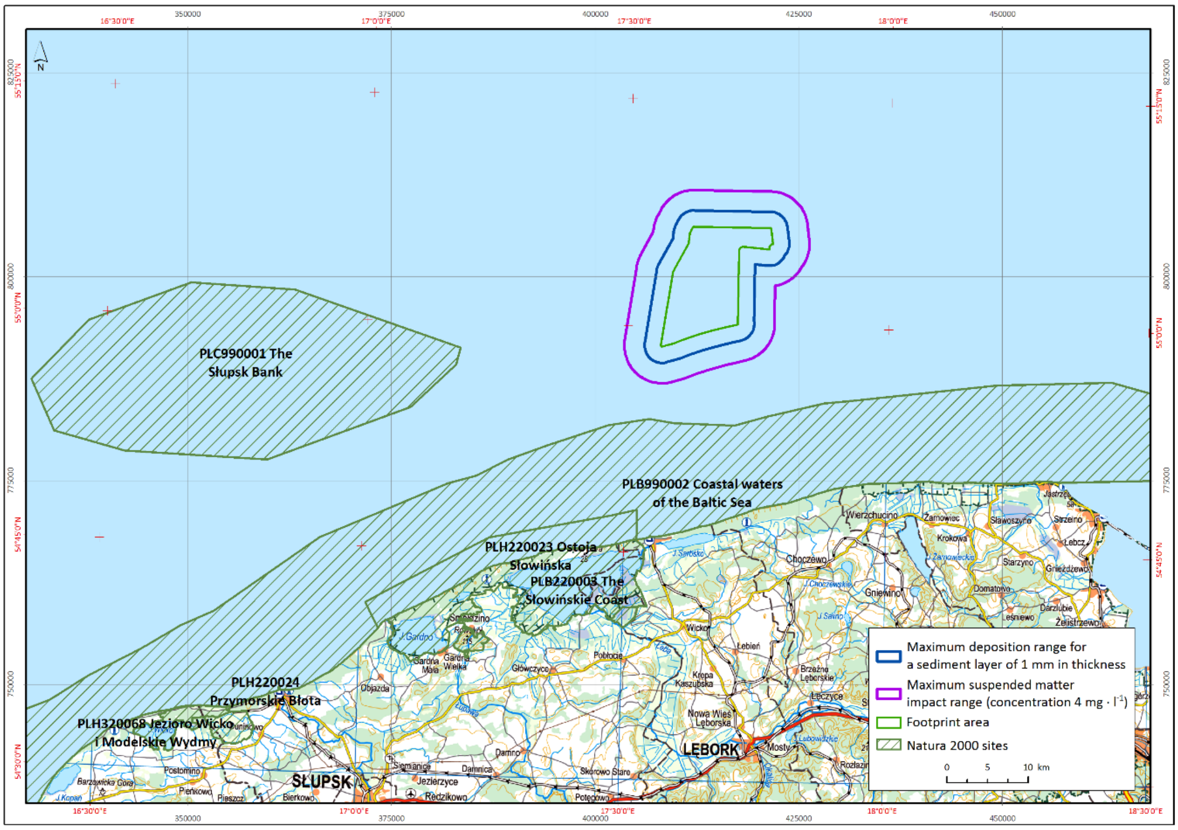


Figure 6.4. *Range of impact of the increase in suspended solids content and the resulting sedimentation for the Baltic Power OWF [Source: internal materials]*

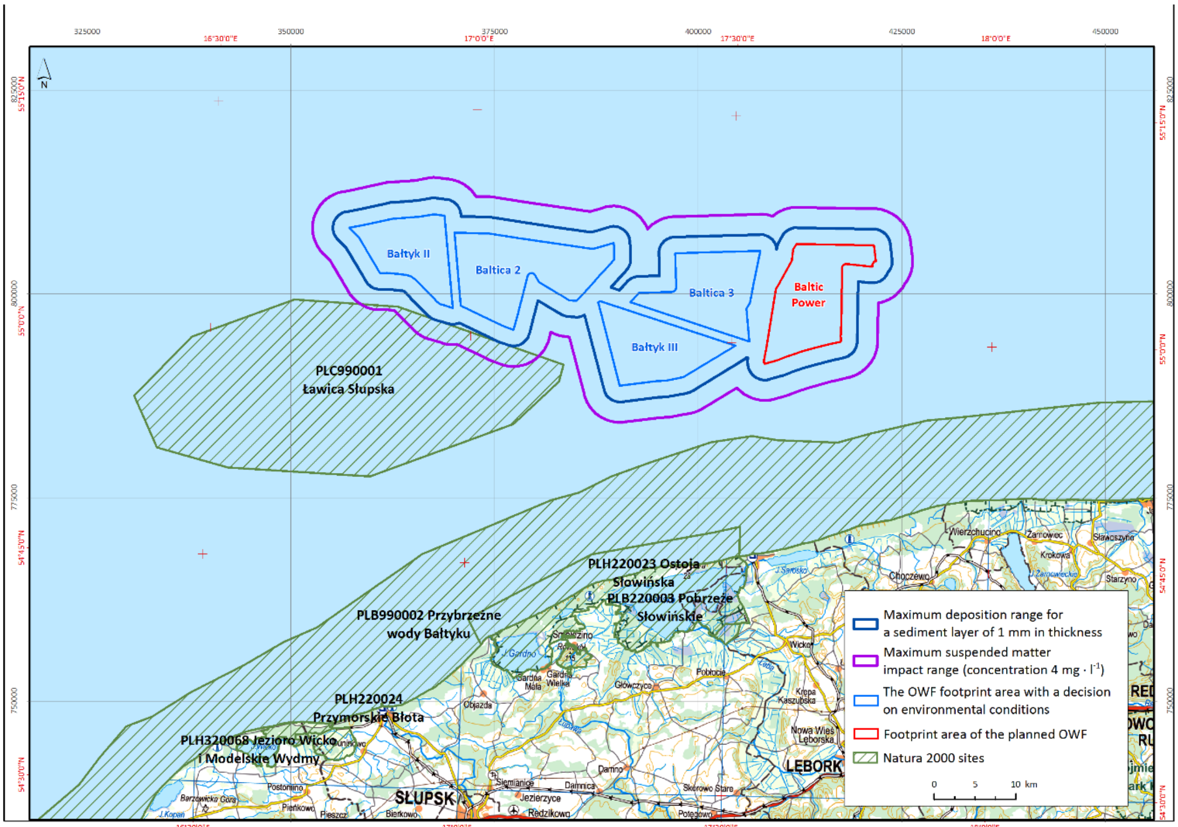


Figure 6.5. Range of impact of the increase in suspended solids content in water and the resulting sedimentation – cumulative for the Baltic Power OWF and other offshore wind farms [Source: internal materials]

6.3.1.1.2 Underwater noise

The ranges of impacts of underwater noise on marine mammals and fish generated as a result of single piling in the Baltic Power OWF Area and as a result of simultaneous pilings within the Baltic Power, Baltica 2, Baltica 3, Bałtyk II and Bałtyk III OWFs (when at least one piling takes place in the Baltic Power OWF Area) were determined using numerical modelling of sound propagation. In the modelling, the worst-case scenario was taken into account during piling in the Baltic Power OWF Area.

Detailed methodology for determining the range of impact of underwater noise generated during piling with the application of NRS and the modelling results are described in Appendix 3 to the EIA Report.

The noise reduction system, which is an integral part of the Baltic Power OWF in the construction phase, is aimed at limiting the underwater noise generated during piling works to such an extent that it is insignificant for marine organisms, i.e. it does not exceed the TTS values within the Natura 2000 sites, where these organisms are the subject of protection.

The TTS value was assumed as the limit of the significant impact of underwater noise on organisms. In the case of behavioural responses of organisms to underwater noise, its impact is discontinuous, short-term and does not cause any significant changes in their behaviour. The issues related to the impact of underwater noise on fish and marine mammals, including the values of individual noise response thresholds, is presented in subsections 6.1 and 6.2.

The ranges of PTS, TTS and the behavioural response for porpoises and seals are shown in the figures (Figure 6.6 and Figure 6.7). For both the porpoise and the seal, the TTS range does not reach the boundary of the Ostoja Słowińska site (PLH220032), where these animals are subject to protection.

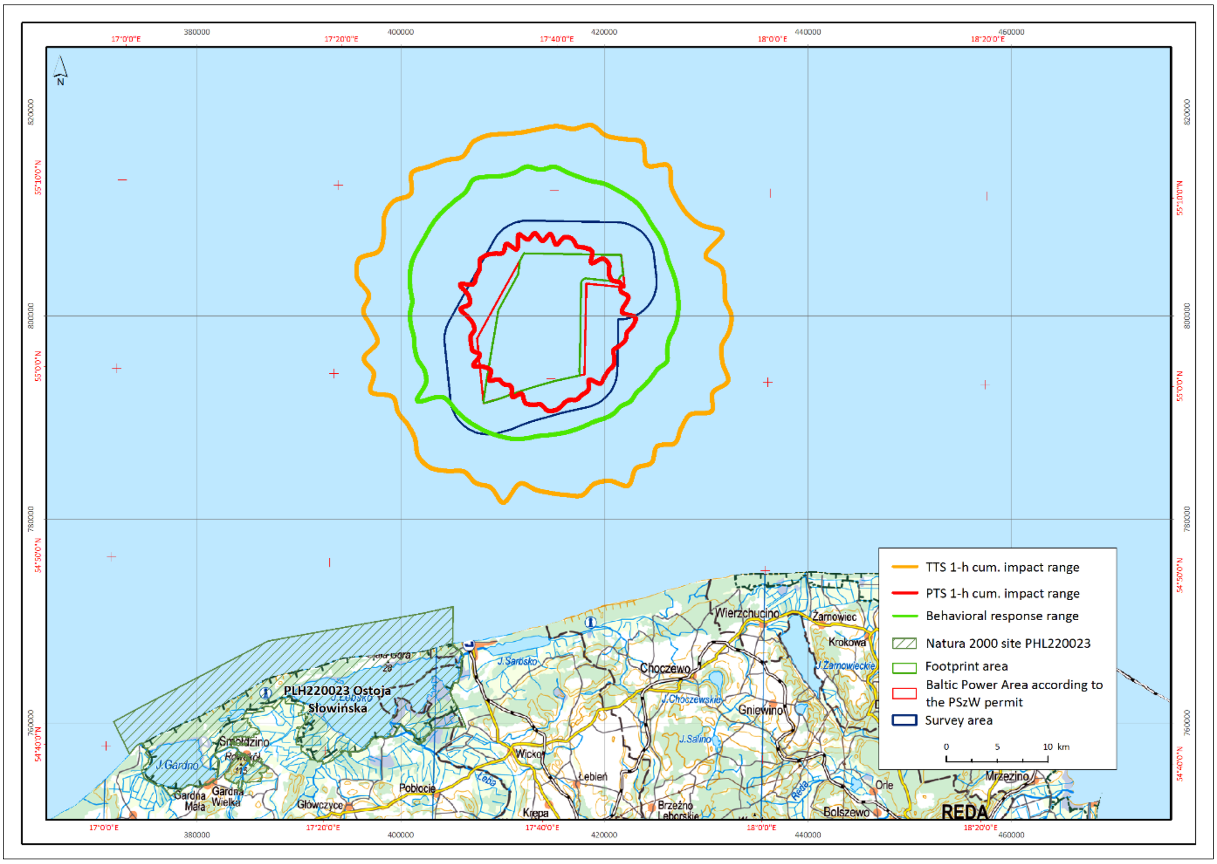


Figure 6.6. Ranges of PTS, TTS and the behavioural response for the porpoise in relation to the area of Ostoja Słowińska (PLH220023) after the application of a noise reduction system [Source: Baltic Power Sp. z o.o. data]

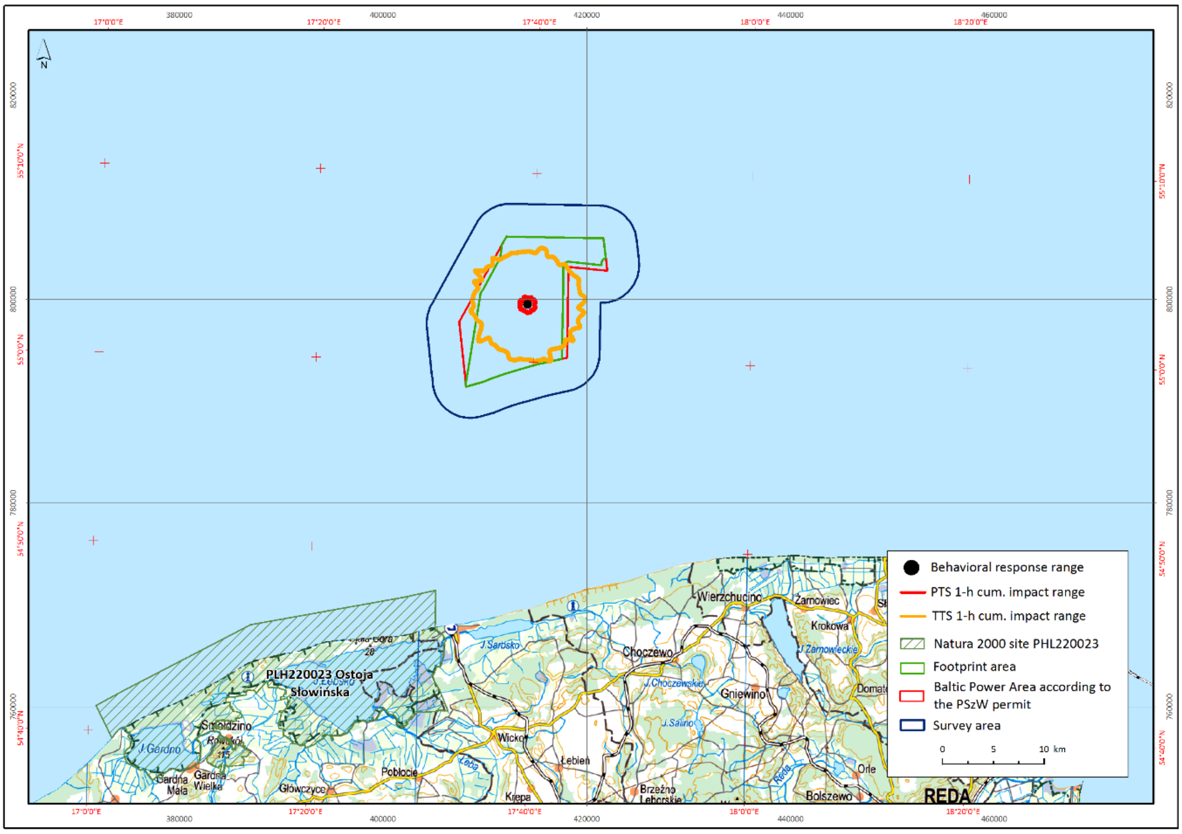


Figure 6.7. *Ranges of PTS, TTS and the behavioural response for the seal in the area of Ostoja Słowińska (PLH220023) after the application of a noise reduction system [Source: Baltic Power Sp. z o.o. data]*

The ranges of PTS, TTS and the behavioural response for fish are shown in the figures below (Figure 6.8 and Figure 6.9). For fish both with and without a swim bladder, the TTS range does not reach the boundary of the area of Ostoja Słowińska (PLH220032), where these animals are subject to protection or may constitute food for marine mammals.

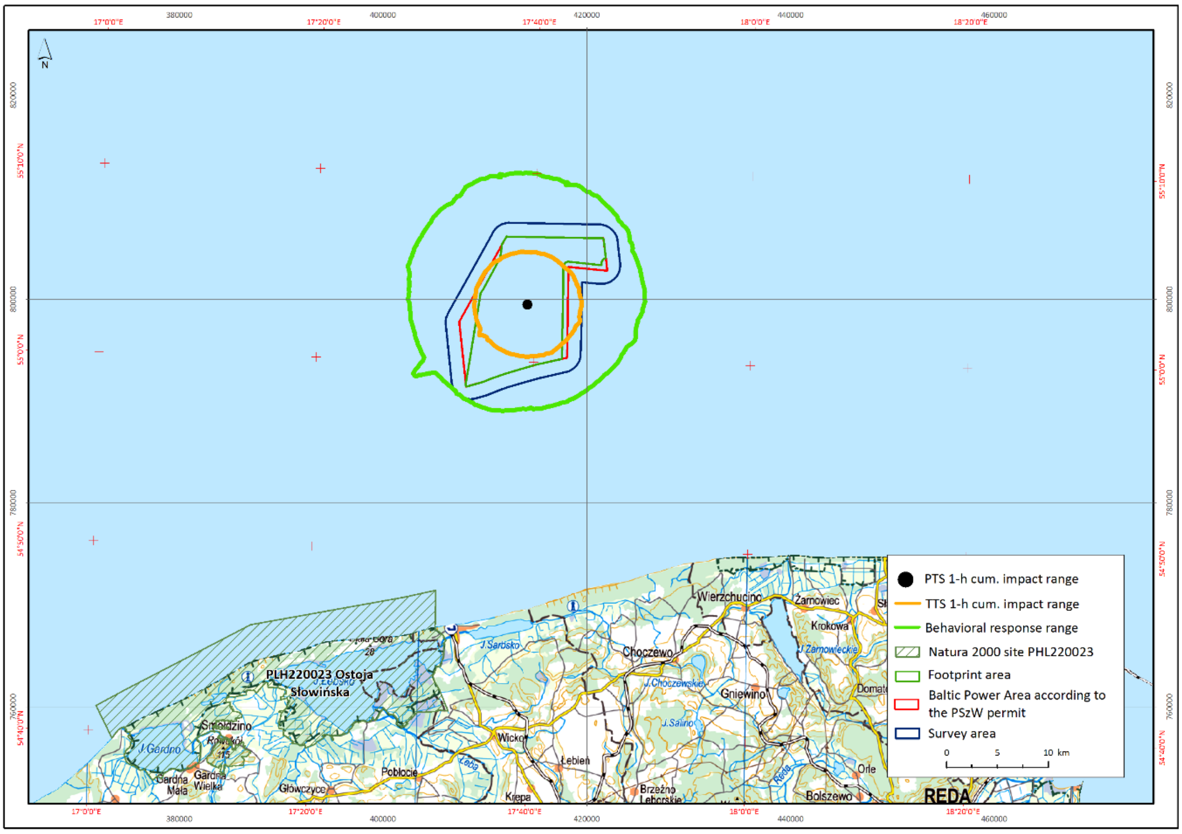


Figure 6.8. *Ranges of PTS, TTS and the behavioural response for fish without a swim bladder in the area of Ostoja Słowińska (PLH220023) after the application of a noise reduction system [Source: Baltic Power Sp. z o.o. data]*

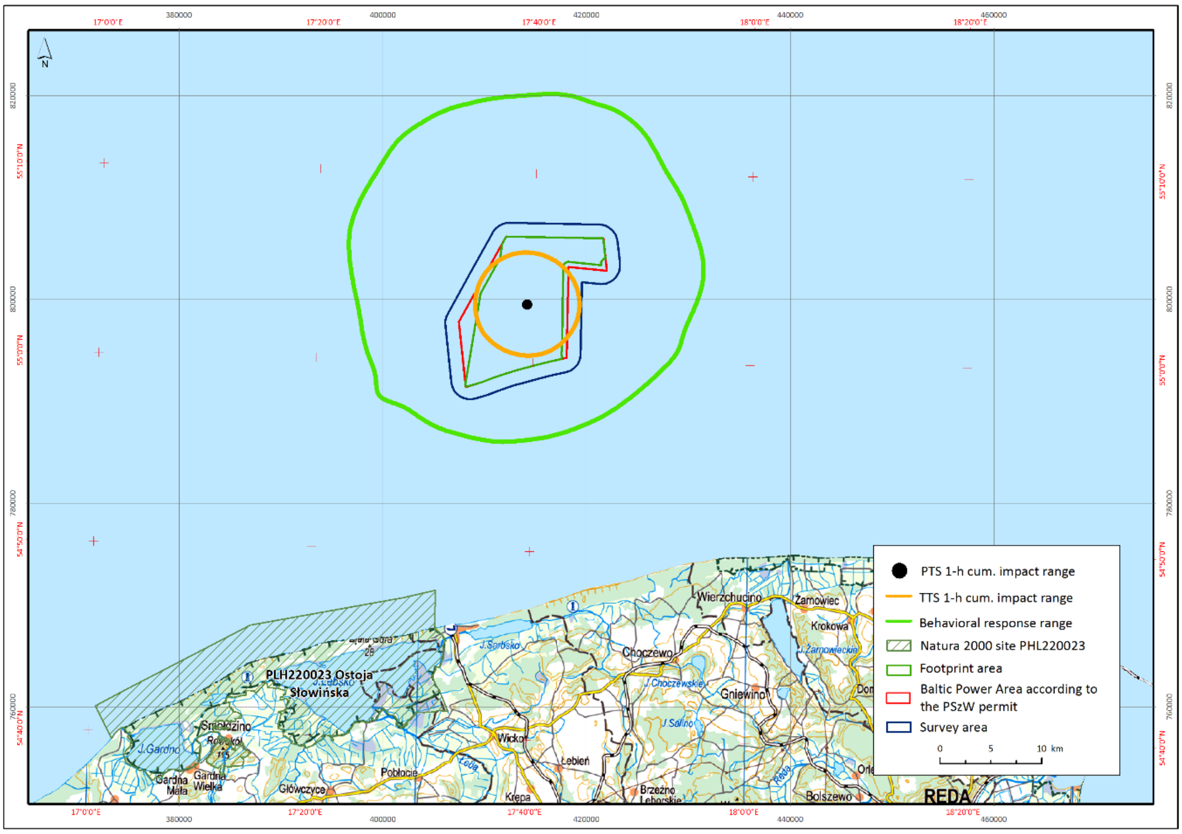


Figure 6.9. *Ranges of PTS, TTS and the behavioural response for fish with a swim bladder in the area of Ostoja Słowińska (PLH220023) after the application of a noise reduction system [Source: Baltic Power Sp. z o.o. data]*

The preliminary assessment also included cumulative impacts for underwater noise that may be generated in connection of the Baltic Power OWF with other OWEs under construction. In addition to the Baltic Power OWF, the analysis of cumulative impacts also covered other planned OWFs for which EIA Reports have been prepared or environmental decisions have been issued. This stage of the OWF project implementation progress enables access to data, assumptions and analyses characterising these projects. In the context of cumulative impacts, the impacts of the Bałtyk II OWF, the Bałtyk III OWF and the Baltica OWF are significant.

It is assumed that in order to avoid significant impacts on Natura 2000 sites for other OWFs, the prerequisite for the implementation of these projects will be to meet the underwater noise levels safe for organisms subject to protection in these areas.

When analysing the ranges of impact of underwater noise on the grey seal, which is subject to protection in the Ostoja Słowińska site (PLH220032), it can be concluded that the range of significant impact (TTS) exceeds the boundary of the Baltic Power OWF Area, however, does not reach the boundary of the Natura 2000 site (Figure 6.10).

In the case of cumulative impact, which includes simultaneous piling works in the Baltica 2 OWF or Baltica 3 OWF area combined with piling works in the Baltic Power OWF Area, the TTS range will also not reach the Ostoja Słowińska site (PLH220032) (Figure 6.11).

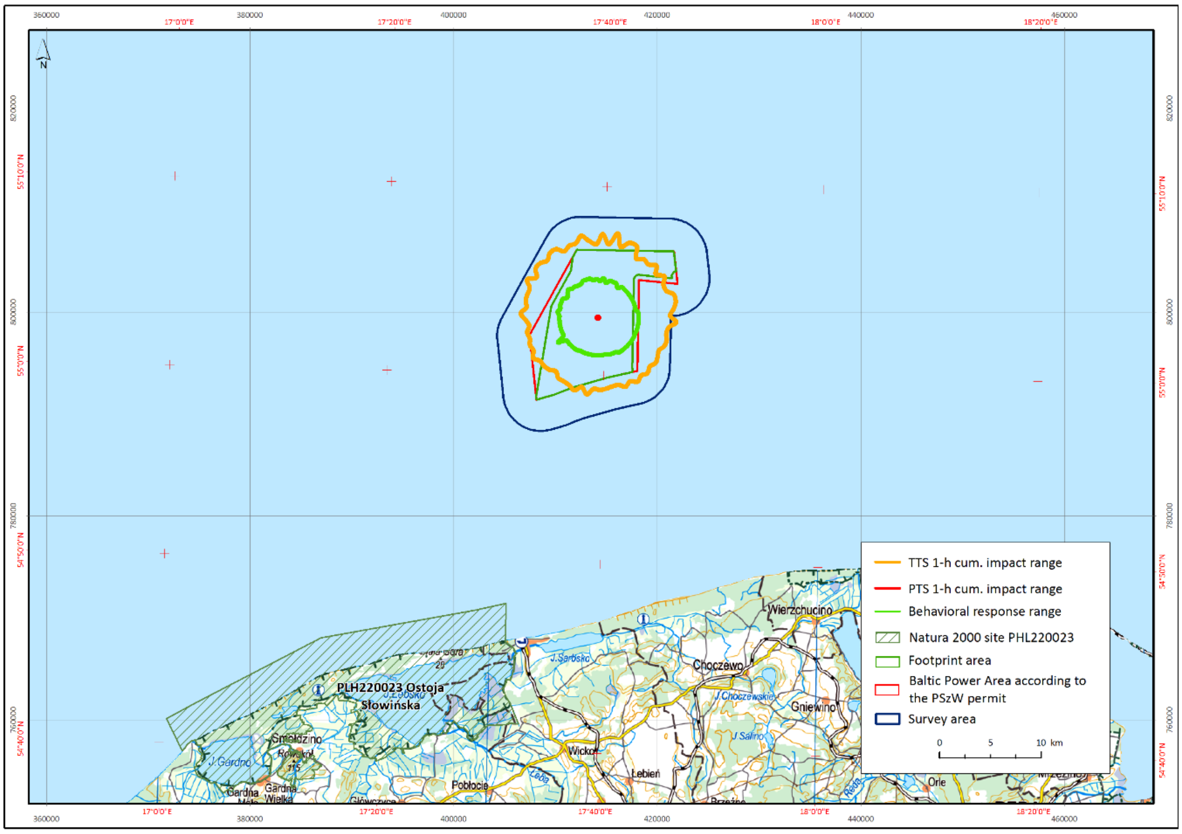


Figure 6.10. Ranges of PTS, TTS and the behavioural response for the seal as a result of piling conducted in two locations within the Baltic Power OWF in relation to the Słowińska Ostoja site (PLH220023) and after the application of a noise reduction system – ranges of TTS and PTS impact for SEL_{cum}; range of the behavioural response impact for an unweighted SEL [Source: internal materials]

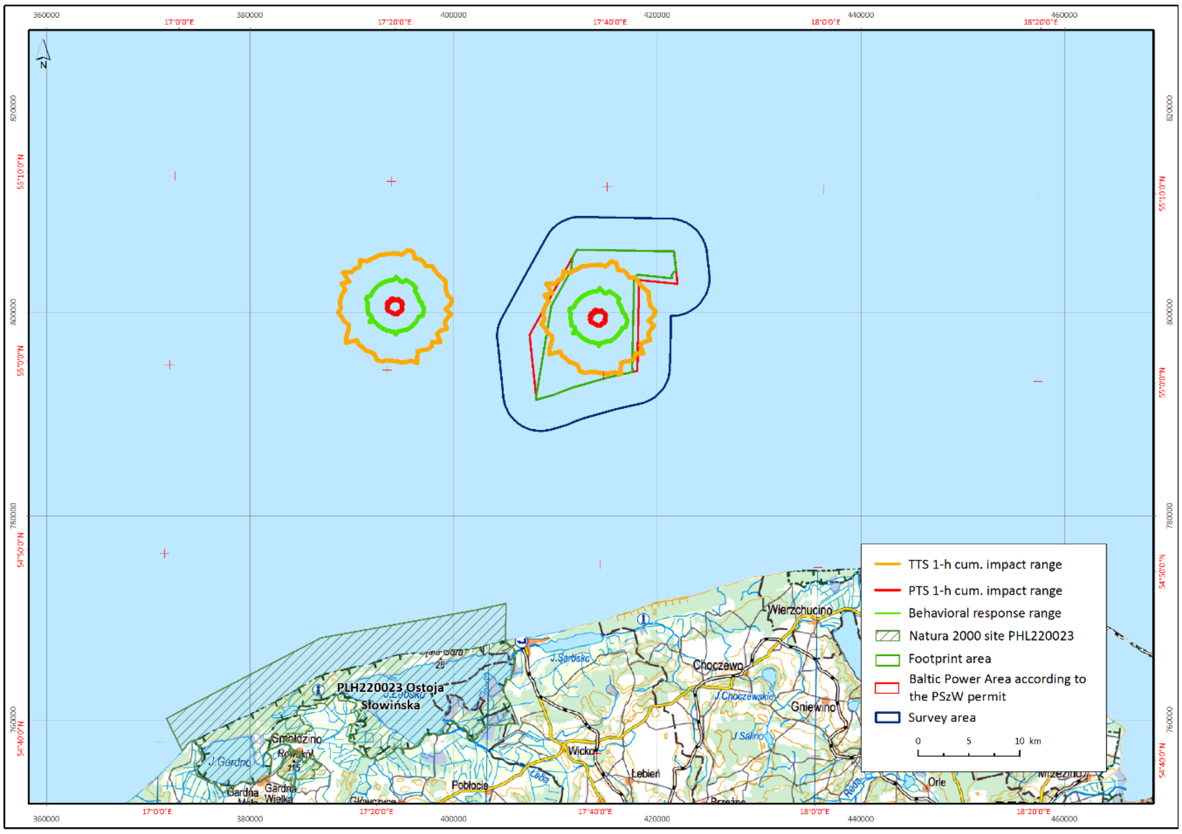


Figure 6.11. Ranges of PTS, TTS and the behavioural response for the seal as a result of piling conducted in two locations 20 km away from each other (including one location within the Baltic Power OWF) in relation to the Słowińska Ostoja site (PLH220023) and after the application of a noise reduction system – ranges of TTS and PTS impact for SEL_{cum}; range of the behavioural response impact for an unweighted SEL [Source: internal materials]

When analysing the ranges of underwater noise impact on the porpoise, which is subject to protection in the Słowińska Ostoja site (PLH220032) and the Hoburgs bank och Midsjöbankarna site (SE0330308), it can be concluded that the range of significant impact (TTS) exceeds the boundary of the Baltic Power OWF Area, but does not reach the protection areas (Figure 6.12).

In the case of cumulative impact, which includes simultaneous piling works in the Baltica 2 OWF or Baltica 3 OWF area combined with piling works in the Baltic Power OWF Area, the TTS range will also not reach the Ostoja Słowińska (PLH220032) and Hoburgs bank och Midsjöbankarna (SE0330308) sites (Figure 6.13).

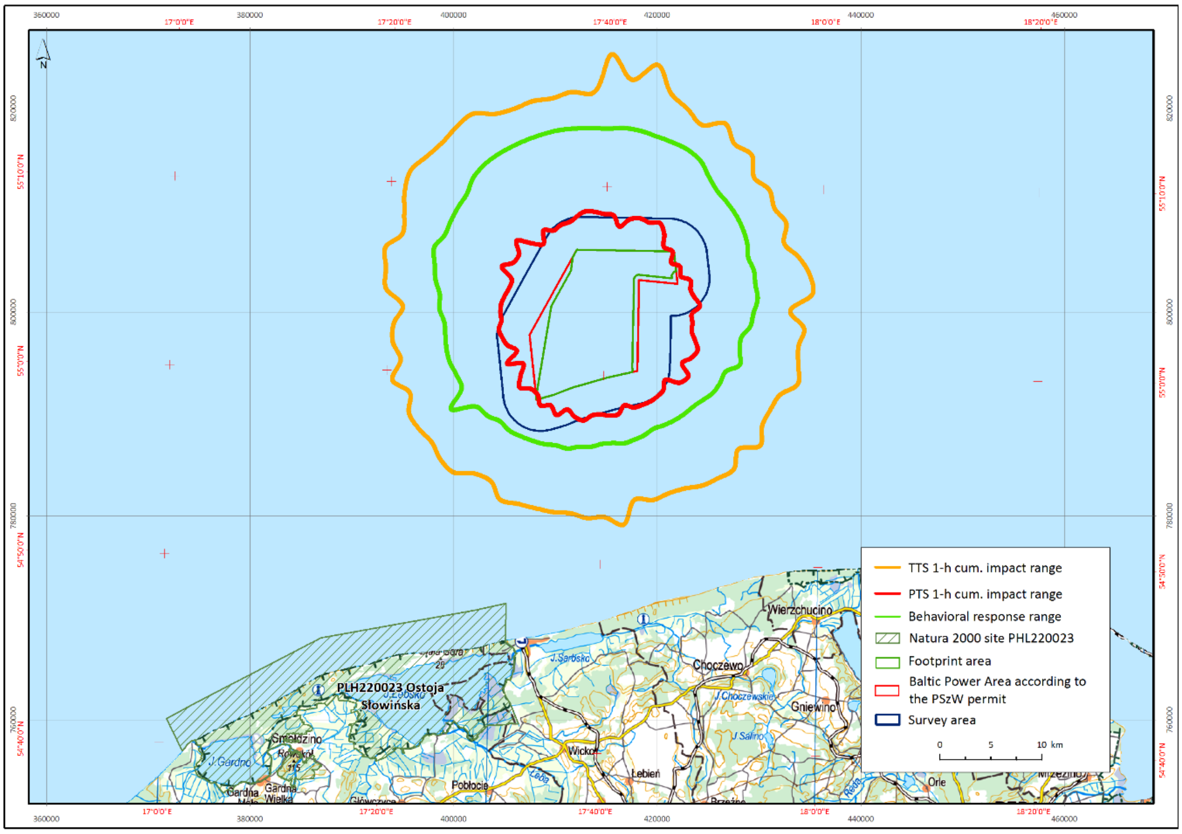


Figure 6.12. Ranges of PTS, TTS and the behavioural response for the porpoise as a result of piling conducted in two locations within the Baltic Power OWF in relation to the Słowińska Ostoja site (PLH220023) and after the application of a noise reduction system – ranges of TTS and PTS impact for SEL_{cum}; range of the behavioural response impact for an unweighted SEL [Source: internal materials]

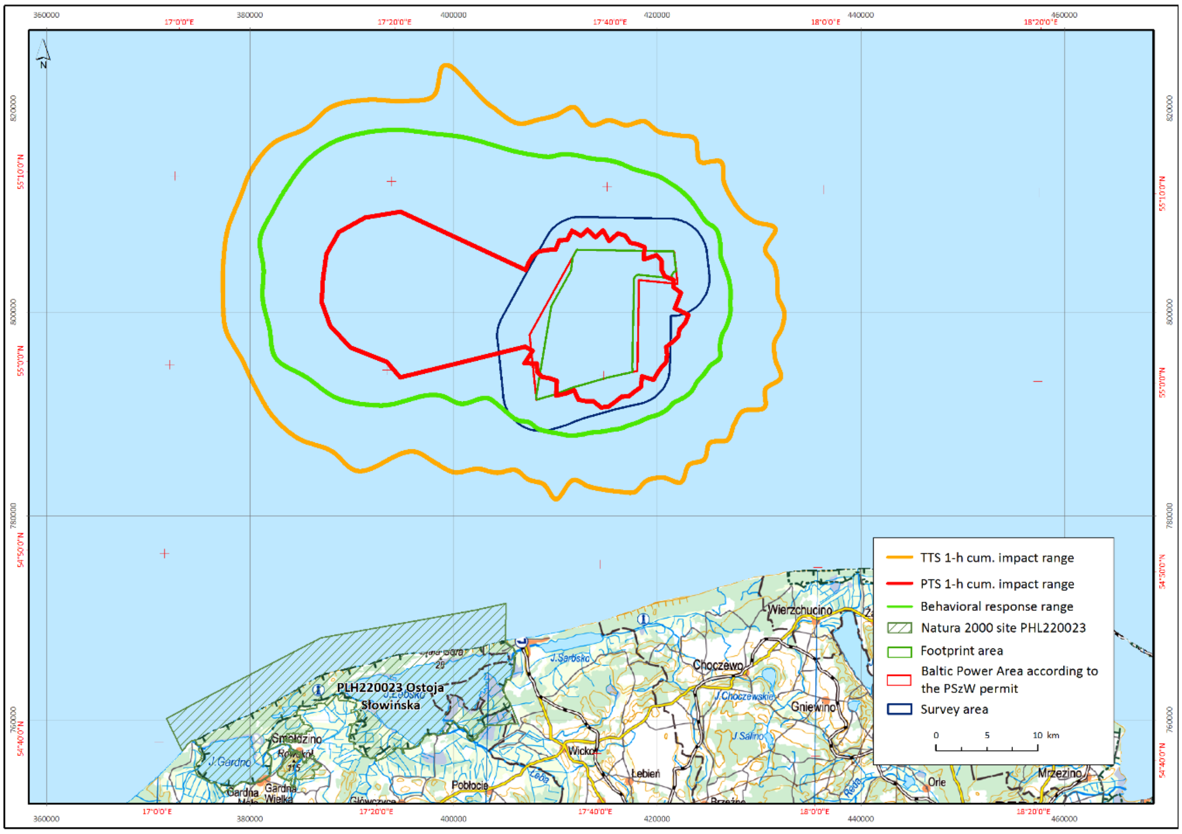


Figure 6.13. *Ranges of PTS, TTS and the behavioural response for the porpoise as a result of piling conducted in two locations 20 km away from each other (including one location within the Baltic Power OWF) in relation to the Słowińska Ostoja site (PLH220023) and after the application of a noise reduction system – ranges of TTS and PTS impact for SEL_{cum}; range of the behavioural response impact for an unweighted SEL [Source: internal materials]*

When analysing the range of impact of underwater noise on fish both with and without a swim bladder subject to protection in the Słowińska Ostoja site (PLH220032), it can be concluded that the range of significant impact (TTS) exceeds the boundary of the Baltic Power OWF Area, however, does not reach this area, similarly as in the case of marine mammals (Figure 6.14 and Figure 6.16).

In the case of cumulative impact, which includes simultaneous piling works conducted in the Baltica OWF, Baltica 2 OWF or Baltica 3 OWF area combined with piling works in the Baltic Power OWF Area, the TTS range will also not reach the Ostoja Słowińska site (PLH220032) (Figure 6.15 and Figure 6.17).

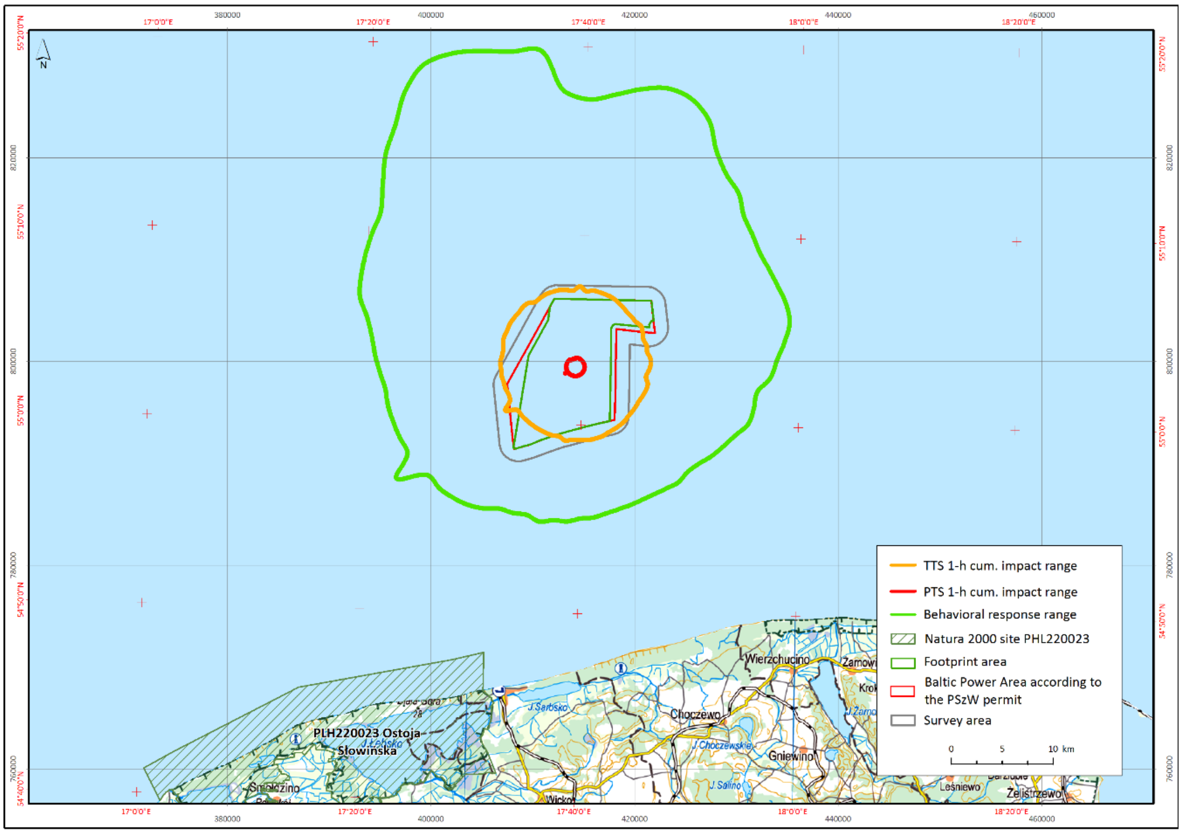


Figure 6.14. *Ranges of PTS, TTS and the behavioural response for fish with a swim bladder as a result of piling conducted in two locations within the Baltic Power OWF in relation to the Słowińska Ostoja site (PLH220023) and after the application of a noise reduction system – ranges of impact for unweighted SEL [Source: internal materials]*

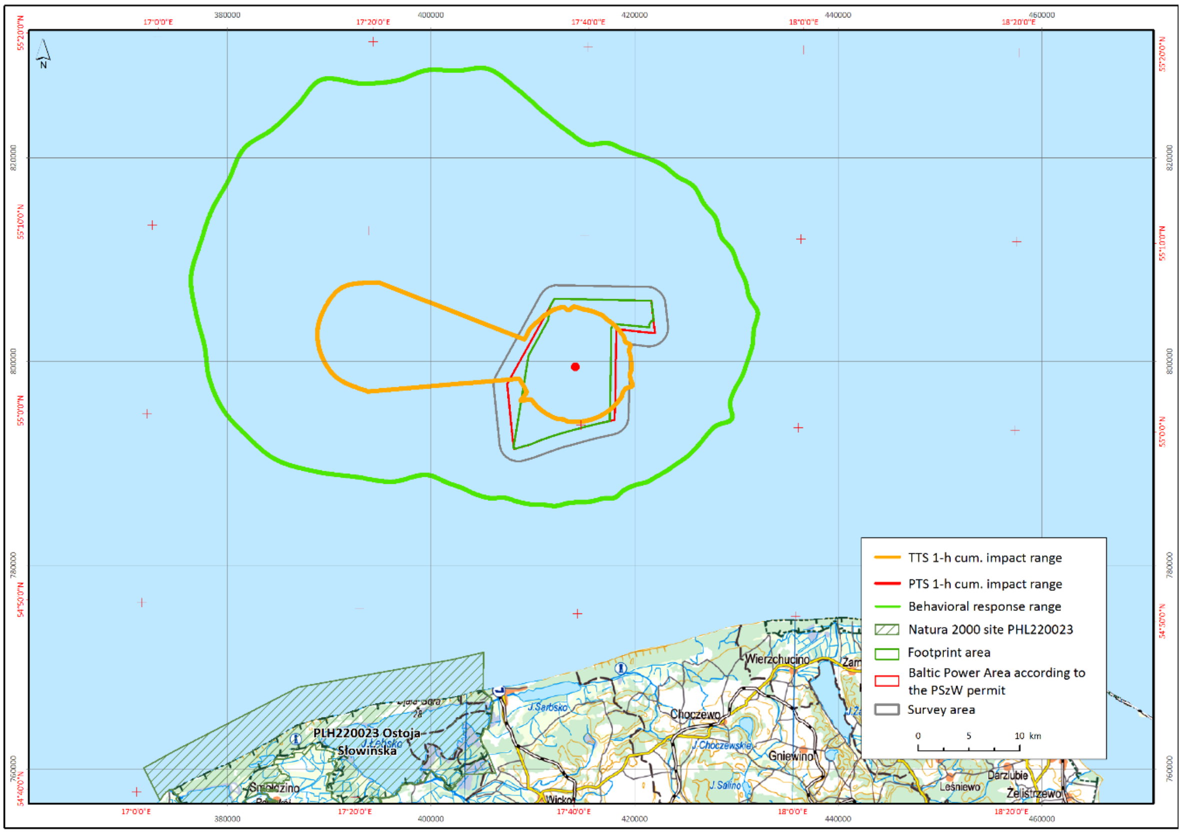


Figure 6.15. Ranges of PTS, TTS and the behavioural response for fish with a swim bladder as a result of piling conducted in two locations 20 km away from each other (including one location in the Baltic Power OWF) in relation to the Słowińska Ostoja site (PLH220023) and after the application of a noise reduction system – ranges of impact for unweighted SEL [Source: internal materials]

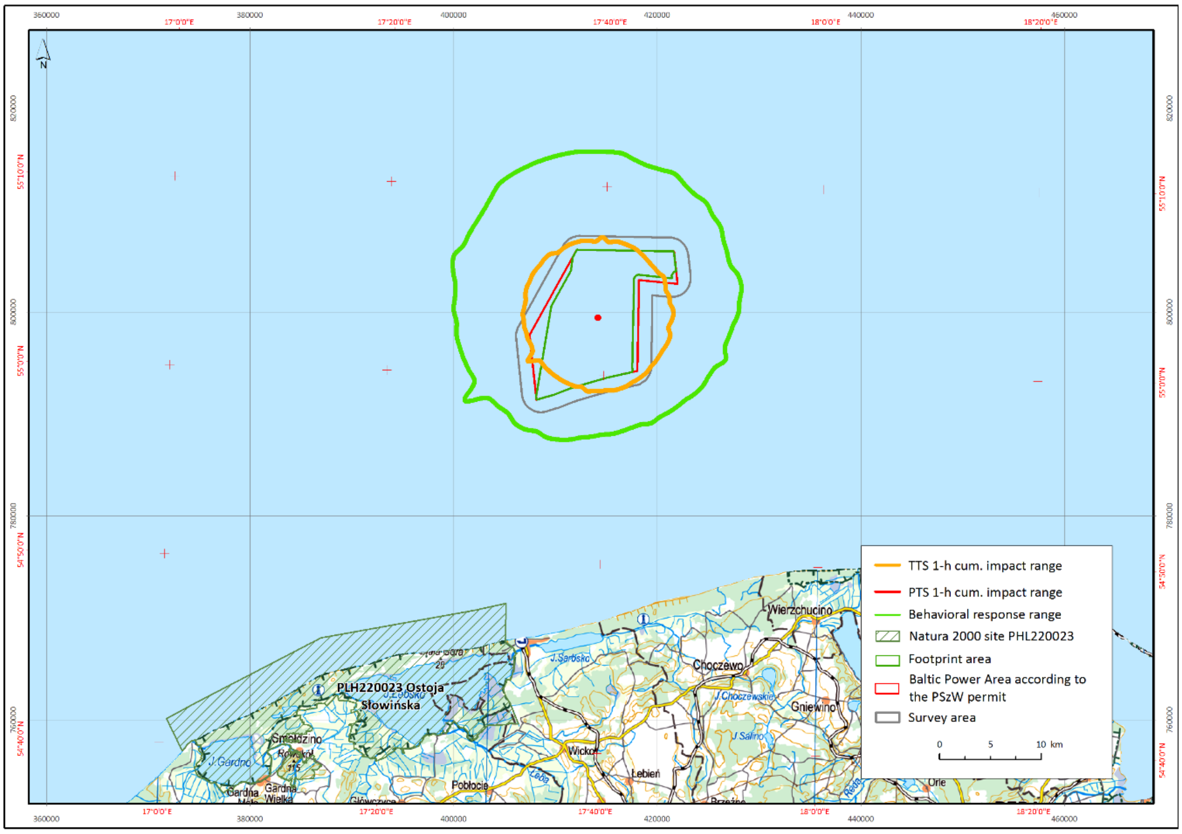


Figure 6.16. Ranges of PTS, TTS and the behavioural response for fish without a swim bladder as a result of piling conducted in two locations within the Baltic Power OWF in relation to the Słowińska Ostoja site (PLH220023) and after the application of a noise reduction system – ranges of impact for unweighted SEL [Source: internal materials]

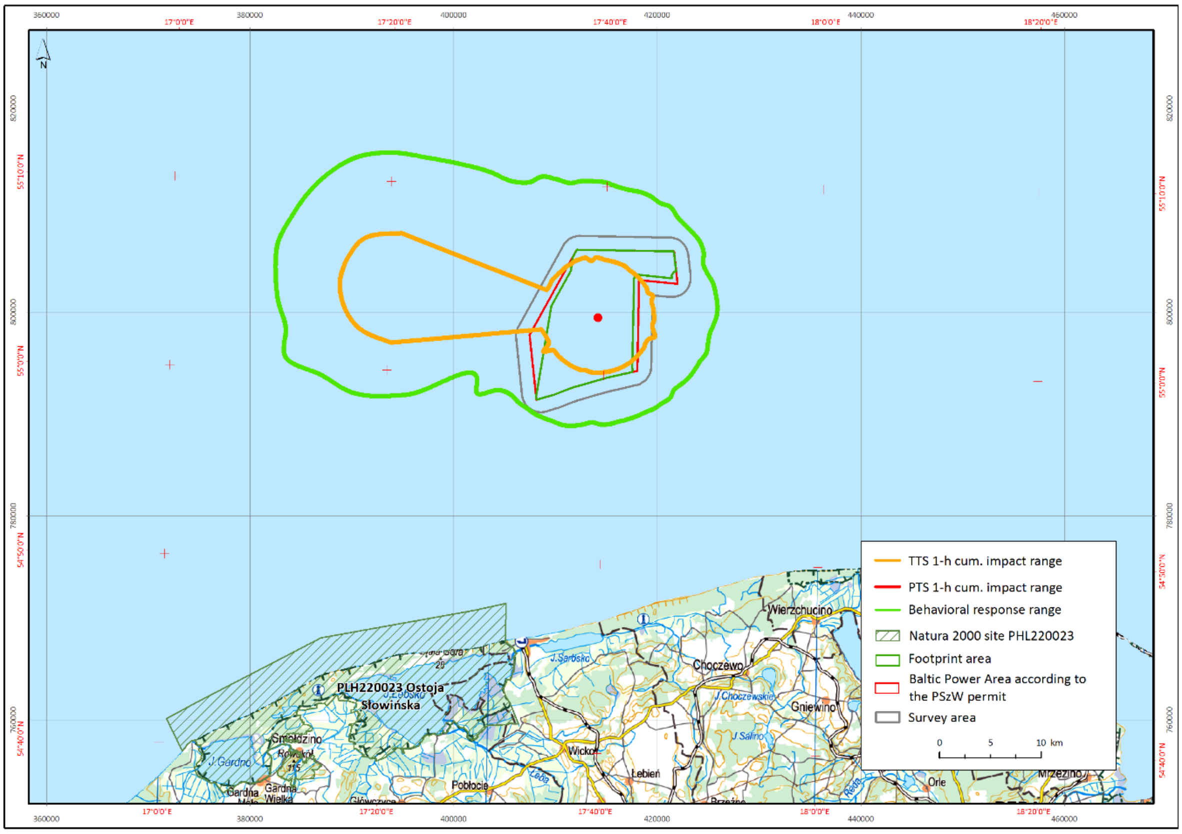


Figure 6.17. Ranges of PTS, TTS and the behavioural response for fish without a swim bladder as a result of piling conducted in two locations 20 km away from each other (including one location in the Baltic Power OWF) in relation to the Słowińska Ostoja site (PLH220023) and after the application of a noise reduction system – ranges of impact for unweighted SEL [Source: internal materials]

6.3.1.1.3 Spatial disturbances

As a result of the implementation of the Baltic Power OWF, large-size structures will be built in the currently undeveloped marine and air space above the maritime area. The maximum height of the wind power stations will be 330 m above sea level and the maximum rotor diameter will be up to 260 m. In the Applicant Proposed Variant (APV), the maximum number of wind power stations will be 126, and the maximum number of additional structures will be 6.

Compared to the current situation (initial state), construction of such a number of large-size structures in the environment may result in a significant disturbance of the coastal space within the Baltic Power OWF Development Area. All structures erected will not form a uniform barrier. The distances between individual wind power stations will be at least four times the rotor diameter. For a rotor with a maximum diameter of 260 m, it will be more than 1000 m. The location of individual wind power stations and platforms will be specified at the design stage.

When comparing these two spaces, the airspace above the maritime area will be occupied to a greater extent. The diameter of submerged structures connecting the foundation or support structure with the towers of the wind power stations will be up to 20 m, whereas the rotor diameter will be up to 260 m. The occupation of airspace above the maritime area will also vary at different heights of the structure. The space from the sea surface to the height of at least 20 m will not be occupied (excluding parts of the wind power station towers).

The sea space, understood as the sea surface including the water depth, is used by fish, marine mammals and birds sitting on the water. Observations carried out in the Danish OWF areas indicate that, due to the possibility of active movement of fish, the construction of structural elements in the sea space will not significantly disturb their migration processes [251]. A similar situation will occur in the case of marine mammals, the sparse arrangement of structural elements in the sea area will not significantly affect their previous behaviour, because their capable of active movement In the case of birds sitting on the water, given the minimum distance of the rotor tips from the water surface (20 m), the limitation of useable space will also be negligible, just like in the case of subsea space for fish and marine mammals.

The airspace above the maritime area is used by migratory birds or seabirds both in seasonal migrations and in local passages between feeding grounds. Disturbances of these passages may affect the populations of birds subject to protection in Natura 2000 sites – Przybrzeżne wody Bałtyku(PLB990002) and Słupsk Bank (PLC990001). In the event of the OWF significant impact on birds caused by the disturbance of airspace, the coherence of the Natura 2000 network could be compromised.

6.3.1.2 Summary of initial assessment

As a result of the preliminary assessment of the impact of the planned project on Natura 2000 sites, given the ranges and nature of impacts, both in the case of the Baltic Power OWF and the impact cumulated with impacts from other projects, it was indicated that none of the Natura 2000 sites is within the range of the impacts. The absence of impacts applies in particular to the subjects of protection (species and habitats) within the areas, which have been established for their protection.

In view of the above, the main impact assessment of the Baltic Power OWF on the Natura 2000 sites covered the aspect related to the probable impact caused by the disturbance of the airspace above the Baltic Power OWF Development Area in the context of the integrity of the Przybrzeżne wody Bałtyku site (PLB990002) and the coherence of the Natura 2000 network.

6.3.2 Main assessment

The Baltic Power OWF exploitation phase was included in the main assessment due to the nature of the impact. During this phase, the airspace above the maritime area will be maximally occupied by the structures of both wind power stations and platforms, so the impact will be the greatest in relation to the remaining phases of the project. During the construction phase, the effect of airspace disturbance will increase from the initial undisturbed state to the maximum state, lasting throughout the entire exploitation phase. During the decommissioning phase of the project, the situation will be reversed – from the maximum state to the undisturbed state.

6.3.2.1 Coherence of the Natura 2000 network

In the context of the protection of seabird populations within the Natura 2000 network, the following features are important for the sites of Słupsk Bank (PLC990001) and the Przybrzeżne wody Bałtyku (PLB990002):

- the location of these areas along the migration route of the Eurasian seabird populations to their wintering sites;
- the availability of these areas for the populations of wintering birds and birds resting during migration;

- appropriate habitat conditions that make these areas attractive as wintering grounds or resting places during seabird autumn or spring migration.

In the context of maintaining the coherence as part of the Natura 2000 network, it is important, above all, to maintain the possibility of movement of seabird populations between the areas without the risk of significant depletion of the population or significant energy expenditures that could affect the ecology and biology, including the survivability of the individuals of those populations.

Currently, prior to the construction of the Baltic Power OWF and other OWF projects in the PMA, the conservation status of birds wintering and migrating in the sites of the Słupsk Bank (PLC990001) and the Przybrzeżne wody Bałtyku (PLB990002) is appropriate.

The assessment of the impact of the Baltic Power OWF on the Natura 2000 sites with respect to birds was conducted on the basis of the results of ornithological surveys performed for the EIA Report, information from the Standard Data Forms for the sites of the Słupsk Bank (PLC990001) and the Przybrzeżne wody Bałtyku (PLB990002), as well as the recommendations of the European Commission's guidance document “Wind energy developments and Natura 2000”.

The results concerning the maximum abundance of selected bird species in the Baltic Power OWF Area and Natura 2000 sites are presented in the table and in the figure (Table 6.18, Figure 6.18). For the comparison purposes, the results of the abundance modelling for the seabird wintering period were used in accordance with the adopted standards, because long-distance movements of birds in the winter period are less likely than in other phenological periods.

Therefore, the assessment covered the suitability and importance of the Baltic Power OWF Area and the neighbouring Natura 2000 sites of the Słupsk Bank (PLC990001) and Przybrzeżne wody Bałtyku (PLB990002) for seabirds (Table 3.11).

Table 6.18. Comparison of the abundances of wintering seabirds in the Baltic Power OWF Area and Natura 2000 sites

Species	**Abundance of birds wintering in the areas [individual]**			
	Baltic Power OWF	**Słupsk Bank (Ławica Słupska) (PLC990001)**	**Fragment of the Przybrzeżne wody Bałtyku site (PLB990002)**	**Total**
Long-tailed duck *Clangula hyemalis*	857	56 656	26 151	83 664
Velvet scoter *Melanitta fusca*	83	28 386	40 957	69 426
Razorbill *Alca torda*	75	51	545	671
European herring gull *Larus argentatus*	117	164	819	1100
Black guillemot *Cepphus grylle*	1*	21*	0	22
Common scoter *Melanitta nigra*	0*	0*	19*	19
Total	1133	85 278	68 491	154 902

**Field survey results*

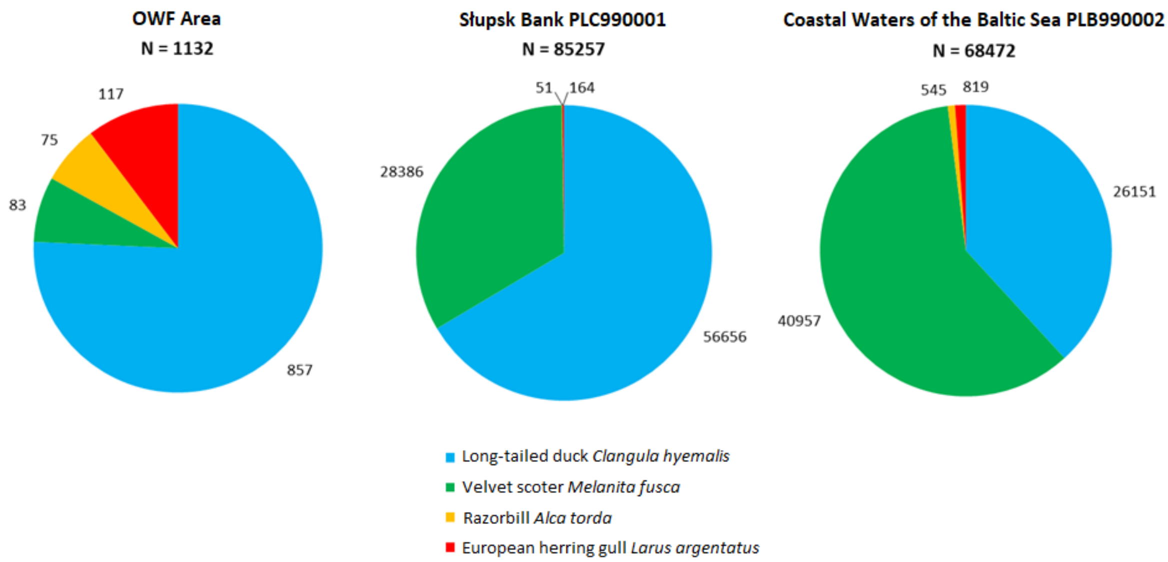


Figure 6.18. Seabird species structure subject to assessment within the Baltic Power OWF and Natura 2000 sites [source: Baltic Power Sp. z o.o. data]

For the comparison purposes, the results of the maximum abundance modelling for the wintering seabirds subject to protection in Natura 2000 sites were used: the long-tailed duck, the velvet scoter, the razorbill, and the European herring gull, prepared as part of the EIA Report. The assessment also included the black guillemot and the common scoter. The black guillemot is subject to protection in the sites of the Słupsk Bank (PLC990001) and the Przybrzeżne wody Bałtyku (PLB990002), but its abundance in the Baltic Power OWF Area was very low. In total, only one individual was recorded during the winter survey campaigns. No black guillemot was observed in the Przybrzeżne wody Bałtyku site (PLB990002), and 21 individuals were recorded in the Słupsk Bank site (PLC990001). It should be noted that these abundances refer only to individuals observed along the route of the survey cruise and are not identical to the total number of black guillemots present in these areas.

The common scoter is subject to protection in the Przybrzeżne wody Bałtyku site (PLB990002), but its abundance in winter in this survey area was very low and amounted to 19 individuals observed along the survey cruise route, with no individuals recorded in the Baltic Power OWF Area.

The winter period was considered representative, as the long-distance movements of birds in the winter period are much less likely than in other phenological periods and the bird abundances are the highest then. The Słupsk Bank (PLC990001) and Przybrzeżne wody Bałtyku (PLB990002) sites are located on the migration route of the Eurasian seabird populations to their wintering sites. The distribution and abundance of birds within them result mainly from the availability of food. From the point of view of habitat conditions that make these areas attractive, the results obtained clearly indicate that the Baltic Power OWF Area, in relation to the Natura 2000 sites compared, is used by birds to a much lesser extent. This is a confirmation of the value and importance of the Natura 2000 sites. Seabirds show strong attachment to their wintering site and are reluctant to move over longer distances [197, 217, 309]. This fact is also confirmed by supplementary surveys carried out in 2020 as part of the of local wintering bird migrations. Radar surveys of migratory birds showed that flying birds that winter in this part of the Baltic Sea travelled in all directions without a clear pattern, which is characteristic of short flights to feeding grounds rather than long-distance movements. It was found that at the observation points located along the Przybrzeżne Wody Bałtyku site, birds more frequently fly in the west-southern and north-eastern directions, i.e. along the coastline. The majority of the flights were recorded in the strip between the Słupsk Bank and the Przybrzeżne Wody Bałtyku Natura 2000 sites.

Although the availability of the Baltic Power OWF Area to the populations of wintering birds and birds resting during migration and subject to protection in the neighbouring Natura 2000 sites will be limited, this impact was assessed as negligible for the long-tailed duck and the European herring gull, and there will be no impact for the black guillemot and the common scoter.

The European herring gulls focus on the open sea in the area of the fishing vessel activity. If fishing is limited in this water area during the construction (or subsequent exploitation) of the Baltic Power OWF, the gulls may relocate to other sites where fishing will be carried out or use new structures protruding from the sea as resting places. Underwater parts of these structures will act as an artificial reef constituting a hard substrate for the macrozoobenthos – food for birds.

Long-tailed ducks, velvet scoters and razorbills staying in the Baltic Power OWF Area before the commencement of the construction works will mostly permanently leave this area, relocating to the neighbouring ones. The populations wintering in the sites of the Słupsk Bank (PLC990001) and the Przybrzeżne wody Bałtyku (PLB990002) so far, where better habitats are located, are not at risk due to the significant distance of these areas from the Baltic Power OWF Area. The potential increase in the long-tailed duck, the velvet scoter and the razorbill densities in both Natura 2000 sites as a result of the relocation of birds previously present in the sea area of the planned project will not have a negative impact on them. In the area of the planned OWF, these species occupied suboptimal habitats, mainly due to an excessive diving depth in search of food, whereas in the Natura 2000 sites, the feeding conditions for the above-mentioned species are optimal, which is indicated by very high values of their density.

Moreover, the existence of corridors (areas with no developments) west and east of the Baltic Power Development Area and between the Baltica 2 OWF and the Baltica 3 OWF will significantly increase the flight possibility for the birds migrating within the area of wind farms in this region.

To sum up, it should be concluded that due to a low abundance of seabirds in the planned project area, no significant negative impacts of the Baltic Power OWF consisting in the displacement of bird species subject to protection from habitats within the sites of the Słupsk Bank (PLC990001) and the Przybrzeżne wody Bałtyku (PLB990002) are expected.

6.3.2.2 Integrity of the Natura 2000 site

Due to the location of the Baltic Power OWF, the issue of the impact of the planned project on the integrity of the Natura 2000 site could be considered in the context of the nearest Natura 2000 site, i.e. the Słupsk Bank site (PLB990002).

The key impact of the Baltic Power OWF on the long-tailed duck is its disturbance and the loss of significant habitats, in which this species winters. As pointed out in the publication of Petersen et al. [323], many years of pre-development and as-built surveys in the Nysted OWF in Denmark show that the long-tailed duck avoids areas with a constructed wind farm. It is also largely displaced from the 2 km zone, and to a lesser extent also from the 2–4 km zone around the boundaries of the area, in which the wind power stations are erected. The decrease in abundance from the 2–4 km zone was no longer statistically significant.

In this context, the site of the Przybrzeżne wody Bałtyku (PLB990002) is located at a relatively significant distance from the Baltic Power OWF Area (more than 8 km) and, thus, the birds will not be disturbed from their habitats located in the Przybrzeżne wody Bałtyku site(PLB990002). Moreover, due to large distances between them and the presence of other suitable habitats at a similar distance, it should not be expected that a large number of birds disturbed from the Baltic Power OWF Area will relocate to the Przybrzeżne wody Bałtyku site (PLB990002). Therefore, it is unlikely that in the Przybrzeżne wody Bałtyku site (PLB990002),negative impacts of the OWF associated with the increase in bird density would occur, especially as the population of avifauna in the Baltic Power OWF Area is low. As a result, negative impacts in the Przybrzeżne wody Bałtyku site (PLB990002) can be ruled out, due to the disturbance and displacement of the long-tailed duck from its habitats..

To sum up, it should be concluded that the Baltic Power OWF is not expected to cause significant negative impacts consisting in the displacement of bird species subject to protection from the habitats within the Przybrzeżne wody Bałtyku site (PLB990002).

6.3.2.3 Summary of main assessment

As a result of the main assessment of the impact of the Baltic Power OWF on the bird species subject to protection in the Słupsk Bank (PLC990001) and Przybrzeżne wody Bałtyku (PLB990002) sites, on the integrity of the Przybrzeżne wody Bałtyku site(PLB990002) and coherence of the Natura 2000 network, it can be concluded that the planned project, both in the APV and in the RAV variants, will not cause any significant impacts on the Natura 2000 sites analysed.

7 Cumulative impacts of the planned project (taking into account the existing, being implemented and planned projects and activities)

The assessment of the cumulative impact of the Baltic Power OWF implementation in connection with other projects included the existing, implemented and planned projects. In the case of the planned projects, only those for which an environmental decision had been issued, were taken into account. This made it possible to reference the impact assessment conducted for the Baltic Power OWF to the results of the assessments conducted for other projects in the context of possible cumulative effect of these impacts.

At present, no other projects that may cause cumulative impacts are being implemented nor will be implemented in the Baltic Power OWF Area. The implementation of the OWF in all its phases, due to the correct and safe functioning of this project, prevents carrying out other activities in the same area. Therefore, the impacts that may possibly accumulate with the impacts of the Baltic Power OWF will have their sources outside its area.

7.1 Projects existing, being implemented and ones for which the decisions on environmental conditions have been issued

In the PMA, there are projects in progress and planned projects related to the extraction of hydrocarbons and gas from under the seabed (Figure 7.1), for which decisions on environmental conditions have been issued, i.e.:

- Reinjection of formation water through the selected existing boreholes to the B3 crude oil reservoir located in the Polish EEZ of the Baltic Sea – existing concession No. 108/94 granted by the Minister of Environmental Protection, Natural Resources and Forestry on 29 July 1994 and the "Łeba" mining area with the surface area of 31.168 km^2, which overlaps the mining region (decision No.: RDOS-22-WOO.6670/62-5/09/AT of 19 October 2009) (hereinafter referred to as the B3 reservoir);
- Extraction of natural gas from the subsea B4 and B6 hydrocarbon reservoirs, as well as its transmission to the systems in the CHPP in Władysławowo (decision No.: RDOŚ-Gd-WOO.4211.12.2014.ER.8 of 16 May 16 2014) (hereinafter referred to as the B4 and B6 reservoirs);
- Extraction of oil and associated natural gas from the B8 reservoir located in the area of the Polish EEZ of the Baltic Sea, using an offshore rig with the possibility of injecting water into the rock mass (decision No.: RDOŚ-Gd-WOO.4211.16.2015.ER.6 of 11 August 112015) (hereinafter referred to as the B8 field);

Moreover, the following four projects related to the construction of the OWF and connection infrastructure in the PMA (Figure 7.1) have obtained decisions on environmental conditions, i.e.:

- Construction of the Bałtyk Środkowy III OWF (decision No.: RDOŚ-Gd-WOO.4211.12.2015.KP.22 of 7 July 2016) (Bałtyk III);
- Construction of an offshore electricity transmission infrastructure (decision No.: RDOS-Gd-WOO.4211.2016.KSZ/AJ.29 of 12 March 2016;
- Construction of the Polenergia Bałtyk II OWF (decision No.: RDOŚ-Gd-WOO.4211.26.2015.KSZ of 27 March 2017) (Bałtyk II);
- Construction of the Baltica OWF (decision No.: RDOŚ-Gd-WOO.4211.21.2017.MJ.PW.AJ.37 of 24 January 2020) (Baltica 2 and Baltica 3).

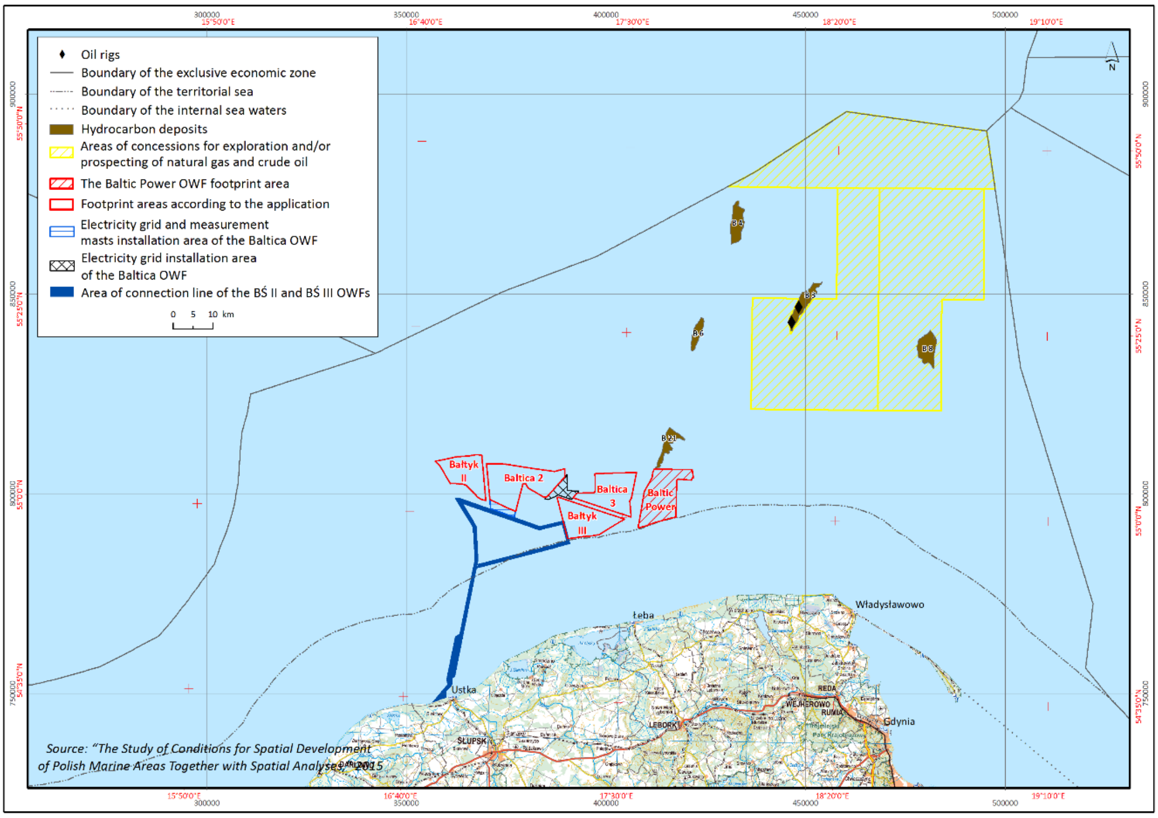


Figure 7.1. Location of the Baltic Power OWF Area in the vicinity of other projects located in the Polish Maritime Areas holding a decision on environmental conditions [Source: internal materials]

Currently, preparatory work is in progress before commencing the OWF construction phases. It is at different stages of progress at different Investors, therefore, among others, the dates of the construction works commencement and their detailed schedules are unknown. The possibility of the cumulative impact occurrence at the construction stage, due to the temporary limitation of the impacts themselves, may take place only in the case work of the same nature is carried out simultaneously or at short time intervals. With the general assumption of all Investors that their OWF construction phase will last several years, it is not possible to clearly indicate, which activities will be performed simultaneously or at short time intervals. However, taking into account the fact that the OWF projects of different Investors will be implemented independently, it cannot be excluded, on the basis of the precautionary principle, that such impacts will not occur.

After the completion of the construction phases, the exploitation phases of individual OWFs will begin. Finally, the beginning of the exploitation phase at the last of the above-mentioned Investors will generate the highest possible cumulative impact, resulting from the cumulation of individual impacts indicated for this phase of the project.

In the case of the OWF decommissioning phases, both the time and the scale of their implementation are currently unknown. With the OWF lifetime assumed, the decommissioning phases will start in several decades. The environmental impacts associated with this phase will be of a different nature and will be significantly smaller than in the case of the construction and exploitation phases. As a result of the commencement of the removal of above-water structures, the space will be gradually reclaimed until the original condition is restored. Also, the removal of underwater structures will be a process of gradual restoration of the condition prior to the OWF construction phase. Assuming that the OWF decommissioning process will be a long-term process, carried out in accordance with the applicable regulations and safety standards with respect to the vessels used, and that all disassembled structural components will be transported to land and utilised there, it may be indicated that even in the case of simultaneous decommissioning in several locations as part of one or several OWFs, no cumulative impacts shall occur.

7.2 Types of impacts which may cause cumulative impact

The assessment of the Baltic Power OWF impacts on individual elements of the environment, including their range and significance, is presented in Section 6. The cumulation of impacts of the Baltic Power OWF with other projects implemented in the PMA may occur, if the activities generating similar impacts are carried out simultaneously. In the case of impacts that have been classified as temporary, simultaneous implementation of the same activities by different investors should be considered rare. Also, the impacts that have been identified as local will not cause cumulative impacts, as in most cases their range will not extend beyond the Baltic Power OWF Area.

In view of the above, the impacts of the Baltic Power OWF that may cause cumulative impacts with other projects, included impacts that are at least medium-term and the range of which exceeds beyond the Baltic Power OWF Area, i.e.:

- underwater noise;
- increase in the concentration of suspended solids and their sedimentation;
- spatial disturbances, including: barriers to the free movement of birds, disturbances in landscape and in the operation of radars as well as restrictions on fishery;

The first two of the impacts indicated will occur during the construction phase, while the third one will occur during the exploitation phase.

7.3 Identification of projects which may cause cumulative impact

The above-mentioned projects, which have been granted the decisions on environmental conditions, can be divided into two groups, i.e. those related to the extraction of hydrocarbons and gas and those related to the generation of wind energy in maritime areas. Each of these groups of projects is characterised by its own specificity, including also different environmental impacts – with respect to their type, range, duration and scale.

In the environmental decisions for the projects related to the extraction of hydrocarbons and gas, the impacts and their significance were indicated. In the context of the impacts characterising the Baltic Power OWF, which may cause cumulative impacts, the impacts related to the extraction of hydrocarbons and gas are not significant enough to cause any cumulative impacts.

The decision on environmental conditions for the B8 Reservoir indicates that the noise related to the operation of machinery on the rig will not be emitted into the water, therefore no harmful impact on the marine environment is expected. Similarly, for the B4 and B6 Reservoirs and the B3 Reservoir, the impact of noise generated during works related to those projects will be irrelevant. In the case of the B4 and B6 Reservoirs, it was indicated that the laying of the gas pipeline will only cause local and periodic water turbidity in the direct vicinity of the work performed. The table (Table 7.1) contains provisions included in individual decisions on environmental conditions, indicating possible impacts resulting from the implementation of these projects.

Table 7.1. Provisions included in the decisions on environmental conditions for the projects: B3 Reservoir, B4 and B6 Reservoirs and B8 Reservoir in the context of environmental impacts [Source: internal materials based on the decisions on environmental conditions issued]

Project	Provisions of the decisions on environmental conditions
B3 Reservoir	Emission of noise to the environment, related to the operation of pumps and other equipment incorporated in the Water Treatment and Injection Plant. The noise intensity applies to the area limited by the structure of the drilling rig. The noise has no harmful impact on the surroundings and the water environment, and as such it is not emitted to the waters around the drilling rig.
B4 and B6 Reservoirs	Since the planned boreholes will be drilled one by one by the same drilling rig, no cumulative impact is expected from the execution of the planned production boreholes in B4 and B6 reservoirs and from prospecting and exploratory boreholes in the neighbouring lands covered by exploratory concessions.
	Pursuant to the results of the EIA Report, underwater noise emitted in connection with the planned work will not exceed the background parameters.
	Impact on ichthyofauna will consist of the local and temporary water turbidity during the excavation and the gas pipeline backfilling, which may have an impact especially on the individuals at an early developmental stage. A ban was introduced on conducting work in the spawning seasons of species permanently present or traveling to spawning grounds in the area of work performed.
	No negative impact on marine mammals is expected due to the low probability of their occurrence in the area of work.
B8 Reservoir	No negative impact of the B8 reservoir exploitation, including the injection of formation water, on the geological structure and pollution of the seabed sediments in the extraction area is expected.
	No noise related to the operation of machinery on the rig will be emitted into the water, therefore no harmful impact on the surroundings and the marine environment is expected.

In the case of the implementation of the four OWFs, i.e. Bałtyk III, Bałtyk II, Baltica 2 and Baltica 3, due to the similar nature of the projects and their almost identical impacts and relatively close location, cumulative impacts may occur. Each of these projects allows a similar method of wind turbine foundation and installation of large-size structures above the water surface. Moreover, regardless of the date of the construction works commencement, the exploitation phase of each of these projects is expected to last several decades, which means that at a certain point in time, the related environmental impacts may occur.

7.4 Cumulative impacts assessment

7.4.1 Underwater noise

The issues of underwater noise in the context of cumulative impacts generated as a result of driving pile foundations or support structures of wind turbines in the Baltic Power OWF Area, with simultaneous piling in the areas of Bałtyk II, Bałtyk III and Baltica, are described in detail in Appendix 3. The modelling results of various possible scenarios regarding simultaneous piling indicated the range of impact, including possible accumulation of impacts. At the same time, these results show that in no case these will be significant impacts, provided that only two simultaneous piling operations are performed in the area covering the Baltic Power OWF, Bałtyk II, Bałtyk III, Baltica 2 and Baltica 3.

7.4.2 Increase in suspended solids concentration and their sedimentation

The issues of the increase in the content of suspended solids and their sedimentation in the context of the impacts of the Baltic Power OWF cumulated with those of Bałtyk II, Bałtyk III, Baltica 2 and Baltica 3 are described in detail in Appendix 2 to the EIA Report.

On the basis of the model calculations conducted, it was found that the cumulative effect of the increase in the content of suspended solids is possible as a result of various anthropogenic activities during the construction phase, but the cumulative impacts will be local and short-term.

Additionally, if works disturbing the seabed sediments are carried out in two locations 3 km away from each other on non-cohesive soils, the cumulative impact does not occur, and the impact is minimal on cohesive soils.

Due to a temporal and spatial separation between the activities carried out within the OWF Area and in the area of the external connection infrastructure, there will be no cumulative impacts as a result of the increase in the content of suspended solids and their sedimentation.

7.4.3 Spatial disturbances

7.4.3.1 Creation of physical barrier

The spatial disturbance created as a result of the construction of the OWF is due to the presence of structures above the water surface, in the water areas that have been free from any physical obstacles so far. Formal conditions indicated in the PSzW permit for the Baltic Power OWF, as well as other OWFs, introduce restrictions on the possibility of this development. They indicate that the distances between individual offshore power plants cannot be smaller than four times the diameter of the rotors. Therefore, the space disturbed is practically limited to the range of rotor operating height. Thus, within the Baltic Power OWF and at other OWFs, a partial, long-term (limited to the exploitation time) reduction in the use of airspace will occur. Undisturbed space will remain within all OWF development areas (between individual wind power stations and accompanying structures) and around the individual OWF Areas. Non-continuous nature of development, with significant distances between the individual OWF structures (at least approx. 1000 m), will make the spatial disturbance non-continuous and uneven. This unevenness will also occur within the structures themselves. The greatest spatial disturbance will occur within the operating range of the rotor, i.e. more than 20 m above the water surface.

Airspace above maritime areas is regularly used by birds, including, in particular, migratory birds. If it is disturbed by the creation of a physical barrier, it will have to be avoided, both in the course of the spring and autumn migrations.

Similarly, as in the case of fishery, taking into account the significance of the potential cumulative impact of the OWF on migratory birds, three other OWFs, the implementation of which is very probable, i.e. the FEW Baltic II, C-Wind and B-Wind, were also taken into account for the assessment of these impacts, in addition to those OWFs, for which the decisions on environmental conditions had been issued (Bałtyk II, Baltica 2, Bałtyk III, Baltica 3). In the case of the first one, in 2019, an EIA Report was submitted to the RDEP in Gdańsk, whereas for the other two, environmental surveys are being conducted for the purposes of the EIA Report preparation. Upon the construction of the last of the OWFs indicated, a maximum spatial disturbance, caused by the presence of the above-water structures located in a large area covering 113.72 km^2, will occur.

When assessing the cumulative impact of the OWF, in accordance with the worst-case scenarioprinciple, the condition in which the exploitation phase of the last of them will begin, was taken into account. This condition will result in the greatest barrier effect.

The creation of a physical barrier has an impact on the bird species migrating on long-distances by changing the route and altitude of their flight, which, in turn, causes an increase in energy expenditure. In order to determine the quantitative impact of the barrier effect of the Baltic Power OWF and other projects planned in this region, the migration route was modified, assuming that migratory birds will perceive the OWF areas as physical barriers that they will avoid at a distance of approx. 1–2 km. The energy costs which took into account the route modification were calculated by including the aerodynamic principle in the calculation of energy expenditures of individual migratory bird species found in the area, while the data concerning the span and surface of wings and body weight before the commencement of migration were taken from professional literature. Detailed results of the model calculations and the impact assessment of a physical barrier on migratory birds are included in Appendix 4 to the EIA Report. Taking into account the projects related to wind energy in the central part of the Southern Baltic (POM.43.E, POM.44.E, POM.45.E and POM.46.E water areas from the draft Spatial Development Plan for the Polish Maritime Areas) and assuming that they will be implemented, it can be indicated that a built-up area with a length of approx. 130 km will be developed. For birds migrating in accordance with the migration directions prevailing in this region, the actual width of the barrier will amount to approx. 90 km. Spatial disturbance at such a long section of maritime areas could lead to a significant disturbance in bird migration.

The development of this space will vary and will depend on the location of wind power stations at individual wind farms. The space between the Baltica 2 OWF and Baltica 3 OWF areas shall remain free from any developments, in accordance with the decision on environmental conditions for the Baltica OWF [98]. This area will enable migration of migratory birds to and from the Słupsk Bank area. It constitutes an actual division of the sequence of the OWF development areas. In order to further divide the OWF development sequence, it is important to plan other areas free from any developments in the area of the created barrier, in particular between the Baltica 3 OWF and the Baltic Power OWF. Moving the development area away from the western boundary of the PSzW permit for the Baltic Power OWF will bring the area free from any developments closer to the bird passage direction prevailing in this area, and at the same time this area will be extended in its narrowest section. Assuming that the optimal width of the corridor between the development areas is 4 km, and taking into account the relatively close location of the corridor between the Baltica 2 OWF and the Baltica 3 OWF to the area between the Baltica 3 OWF and the Baltic Power OWF, it can be assumed that this area will play an auxiliary role in the passage of birds during their migration, absorbing the migration flow of less sensitive species.

Taking into account the possibility of further division of the OWF development sequence in the eastern direction, it is justified to consider a designation of an area free from any developments with a width of 4 km along its entire route east of the Baltic Power DA. Such a corridor could be limited by its western boundary, based on the extreme eastern point of the Baltic Power DA and the south-eastern bending point of the Baltic Power DA boundary. This corridor would be an optimal area, in terms of width and direction, for the passages of migratory birds. The creation of this corridor, in connection with the corridor between the Baltica 2 OWF and the Baltica 3 OWF and the corridor between the Baltica 3 OWF and the Baltic Power OWF of secondary importance to birds, will create a system of development-free areas in the region, enabling the movement of birds in a manner minimising potential disturbances of their migration.

Currently, not having full knowledge about the possible behaviour of birds in the context of such an extensive disturbance of space that is used by them during migration periods, and taking into account the precautionary principle, the system of migration corridors west and east of the Baltic Power DA proposed above can be considered a favourable solution from the point of view of birds that use this region both for migration and local passages.

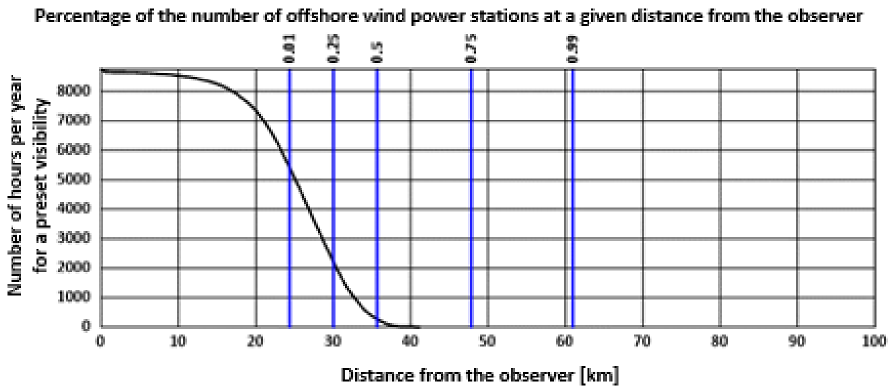
On the basis of the surveys conducted and with the application of the solution consisting in leaving the proposed areas (corridors) between the OWFs free from any development, the significance of the cumulative impact in the form of a physical barrier was assessed to be at most insignificant.

7.4.3.2 Landscape disturbances

Landscape disturbances in the case of cumulative impacts related to a simultaneous exploitation of the Baltic Power, Baltica, Bałtyk II and Bałtyk III OWFs, as described in subsection 6.1.2.9, depend mostly on the weather conditions – visibility and the Earth curvature.

Figure (Figure 7.2) illustrates the number of hours per year with a particular visibility (how often the visibility is greater than a specific value) on the basis of the data from the atmospheric model UMPL (Unified Model for Poland) (calculated by the Interdisciplinary Centre for Mathematical and Computational Modelling, University of Warsaw – data from approx. 5 years). The values are shown for 4 locations – Łeba, Lubiatowo, Dębki and Jastrzębia Góra. The charts clearly show that in the case of Jastrzębia Góra, there will be no situation in which the Baltic Power, Baltica, Bałtyk II and Bałtyk III OWFs will be visible from this town. In the case of Łeba, single wind power stations may be visible even for approx. 5000 hours per year, but 50% of wind power stations installed at those OWFs may be visible for a very short period of time (several dozen hours per year). In the case of Lubiatowo, single wind power stations may be visible for more than 5000 hours per year, and 25% of wind power stations installed at the OWFs subject to assessment may be visible for up to 500 hours per year. An observer from Dębki can see individual wind power stations for almost 1000 hours per year, but in practice, they will never see more than 25% of the wind power stations installed.

A)



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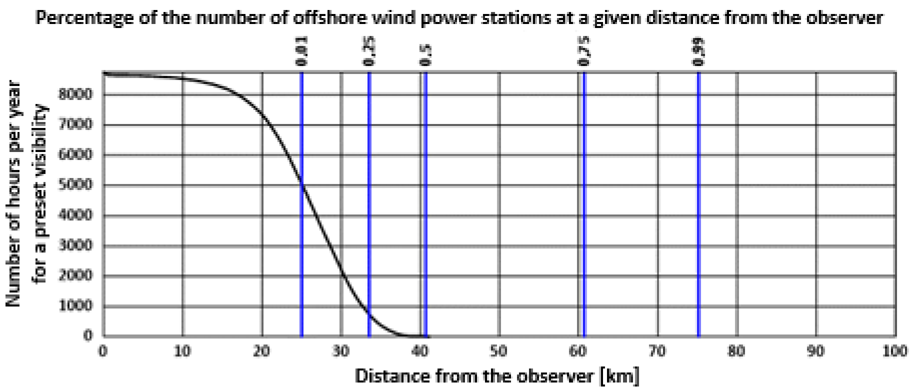

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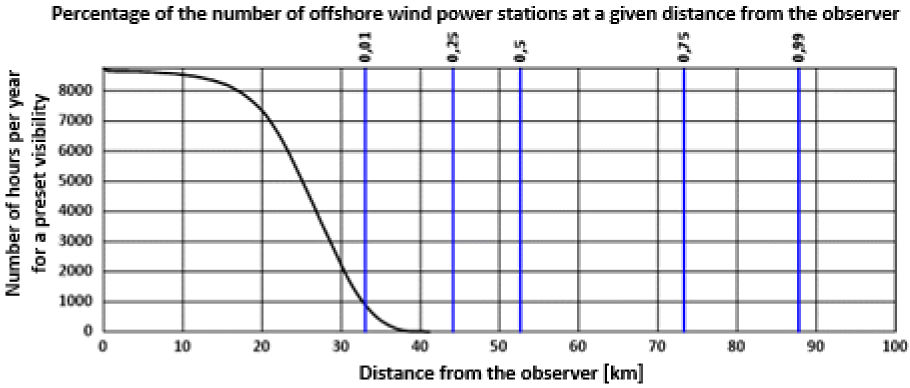

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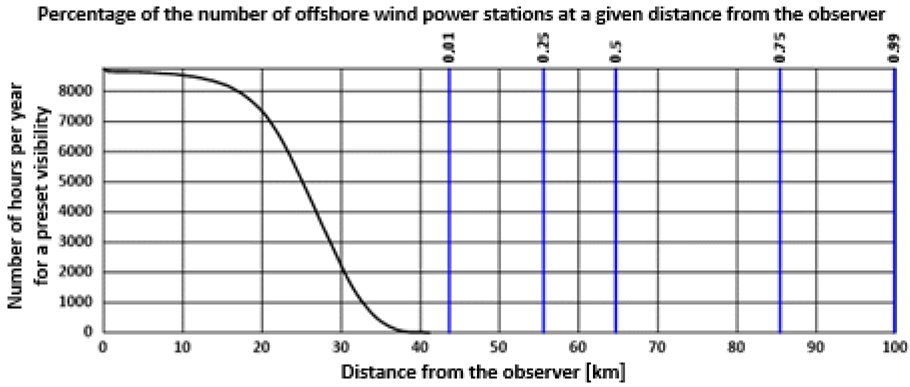

Figure 7.2. Number of hours per year for a preset visibility (distance from the observer) together with the distances marked for offshore wind power stations in the Applicant Proposed Variant in the cumulative version with the Baltica, BŚ II and BŚ III OWFs (the total number of offshore wind power stations and other large-size structures assumed – 611); Chart A – Łeba, B – Lubiatowo, C – Dębki, D – Jastrzębia Góra [Source: internal materials]

Additionally, another limitation of the visibility of wind power stations from the mainland is the Earth curvature and the related limitation of the height of facilities that can be seen from a large distance. In practical terms, this limitation manifests itself by the fact that the further the offshore wind power stations are located from the observer, the fewer of them can be seen. Photos (Photo 7.1, Photo 7.2) present the visualisations of the views of the Baltic Power OWF together with the Baltica, Bałtyk II and Bałtyk III OWFs from Lubiatowo and Dębki.

Photo 7.1. Visualisation of the view of the Baltic Power OWF together with the Baltica, Bałtyk II and Bałtyk III OWFs from Lubiatowo [Source: Baltic Power Sp. z o.o. data]

Photo 7.2. Visualisation of the view of the Baltic Power OWF together with the Baltica, Bałtyk II and Bałtyk III OWFs from Dębki [Source: Baltic Power Sp. z o.o. data]

As in the non-cumulative scenario, the impact was assessed as negligible, although it varies depending on the distance of the observer from the OWF. In the open sea, the landscape is not disturbance-resistant, but its value is not high, as very few people and over a short period of time will be exposed to landscape change, and some of them (e.g. tourists) may perceive it as beneficial or interesting. The impact will have a large spatial range, but the further the distance from the OWF, the smaller it will be. This will be a long-term but reversible change. On the mainland, the upper parts of the OWF may be visible occasionally (Photo 7.1, Photo 7.2).

Visualisation of the view of the Baltic Power OWF together with the Baltica, Bałtyk II and Bałtyk III OWFs is additionally included in Appendix 5 to the EIA Report.

7.4.3.3 Interference in the operation of systems using EMF

The space above the OWF areas is used for the operation of systems using electromagnetic field, such as: vessel navigation radars, coastal radar systems, radio communication equipment and systems for radio and terrestrial television signal transmission. The construction of a single wind farm, as well as a larger number of wind farms may cause disturbances in the proper functioning of these systems. The size of disturbances would be directly proportional to the number of structures built in maritime areas and could cover a proportionally larger maritime area.

Taking into account the possible negative effects resulting from disturbances in the systems using electromagnetic field, in the PSzW permit issued, the Minister for Maritime Economy obliged the Investors to perform a number of specific actions. These actions will aim to ensure the defence and state security as well as the safety of navigation.

The necessity to perform these compensatory actions indicates that the impact of the Baltic Power OWF and other OWFs on the systems using electromagnetic field should be considered only hypothetical and that it will not actually occur.

7.4.3.4 Fishing

Taking into account the significance of the potential cumulative impact on the aspects related to the sea fishing in connection with the construction and exploitation of the OWF, three other OWFs, the implementation of which is very probable, i.e. FEW Baltic II, C-Wind and B-Wind, were also taken into account for the assessment of these impacts, in addition to those OWFs for which the decisions on environmental conditions were issued (Bałtyk II, Baltica 2, Bałtyk III and Baltica 3). In the case of the first one, in 2019, an EIA Report was submitted to the RDEP in Gdańsk, whereas for the other two, environmental surveys are being conducted for the purposes of the EIA Report preparation. Therefore, there is a reasonable likelihood that upon the construction of the last of the OWFs indicated, a maximum space disturbance will occur caused by the presence of the above-water structures.

Considering the space used in fishing activity as more than just the space above the water surface, the cumulative impact assessment also took into account the OWF connection infrastructure. At the moment, the decision on environmental conditions has been issued for the Offshore Connection Infrastructure connecting Bałtyk II and Bałtyk III with the land. The area of the connection infrastructure route between Baltica 3 and the land is also known, however, with no specification of the cable routes (Figure 7.3).

All the above-mentioned projects will have an impact on the activities related to sea fishing, whereas the presence of the above-water structures will cause two possible types of impacts resulting from space limitations, i.e.: no possibility of fishing within the OWF Area and the necessity to avoid the OWF on the way to and from the fishing grounds located north of the OWF. In the case of transmission infrastructure in its immediate vicinity, fishing, in particular with bottom trawls, will not be possible either.

The planned projects related to the implementation of the OWF and transmission infrastructure, located within the 14 fishing squares (K8, L8, M8, N8, O8, P8, L7, M7, N7, O7, P7, L6, O6, and L5), will occupy a total surface area of 1395.4 km^2. This value is overestimated due to the lack of information on the cable routes for the connection from the Baltica 3 OWF. However, applying the envelope principle, i.e. conducting the impact assessment for the largest values describing a given project, the entire surface of this area was taken into account for further analyses.

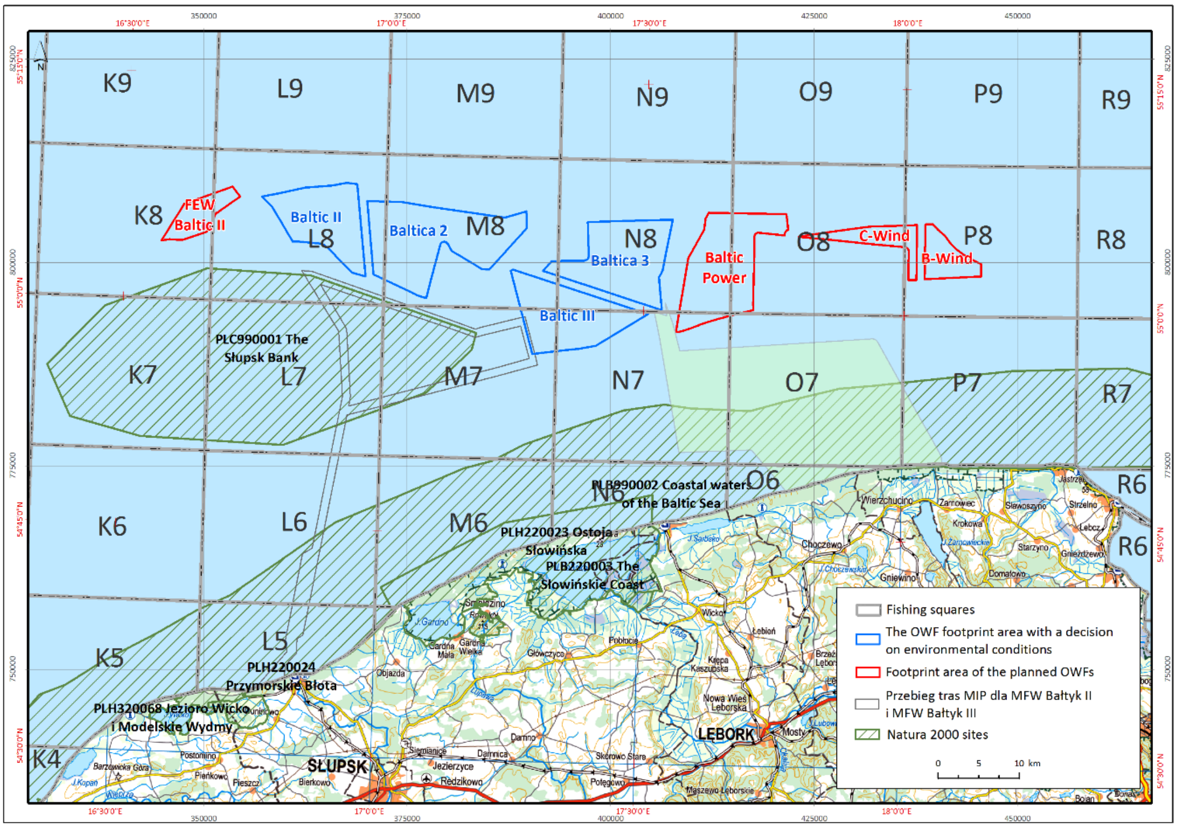

Figure 7.3. Location of the OWF and areas planned for the connection infrastructure against the background of fishing squares [Source: internal materials]

In the years 2014–2018, from 121 to 170 fishing vessels fished to a smaller or larger extent, in the fishing squares indicated, which accounted for 15 to 20% of all fishing vessels registered in Poland (Table 7.2) that carried out fishing in the Baltic Sea.

Table 7.2. Number of vessels fishing in the squares occupied by the OWF and its connection infrastructure and the total number of vessels registered in the years 2014–2018

Year	Number of fishing vessels conducting catches		Share of vessels fishing in the fishing squares occupied by the OWF and its connection infrastructure in relation to the number of vessels fishing in the Baltic Sea and registered in Poland [%]
	In the fishing squares occupied by the OWF and its connection infrastructure	In the Baltic Sea and registered in Poland	
2014	170	870	20
2015	166	872	19
2016	142	839	17
2017	121	831	15
2018	150	825	18

In the years 2014–2018, the value of catches in the fishing squares in the area where the OWF and the connection infrastructure will be located, ranged from PLN 4.7 to 7.1 million, with an average value for this period of PLN 5.8 million (Table 7.3). This represented between 2% and 3% of the catch value of the Polish Baltic fishing. The volume of catches obtained in the individual fishing squares varied significantly. The largest average catch values obtained in the P8 and L8 squares, in the years 2014–2018, equalled PLN 863 thousand and PLN 657 thousand respectively. The surface areas of these fishing squares are to be occupied by the OWF and its connection infrastructure in 14.5% and 44% respectively. The value of the completed catches, estimated on the basis of the share of the areas occupied by the OWF together with its connection infrastructure in relation to their total surface area, amounted on average to PLN 1.5 million in 2014–2018 and ranged from PLN 1.1 million in 2018 to PLN 1.9 million in 2014. This represented between 0.5% and 1% of the catch value of the Polish Baltic fishing.

Table 7.3. Catch value for the fishing squares in the area of the planned OWF location

Fishing square	The value of catches [thousand PLN]					Average value of catches in 2014–2018 [thousand PLN]
	2014	2015	2016	2017	2018	
K8	173	189	221	55	512	230
L8	871	640	759	549	469	657
M8	436	339	622	527	314	448
N8	146	209	152	250	57	163
O8	240	383	119	374	160	255
P8	766	1119	362	1278	789	863
L7	316	460	363	246	449	367
M7	456	403	510	313	370	410
N7	290	308	241	271	226	267
O7	297	363	201	145	144	230
P7	640	768	559	235	94	459
L6	524	711	674	240	568	543
O6	545	462	223	151	217	320
L5	674	773	842	410	287	597
Razem	**6372**	**7126**	**5847**	**5046**	**4656**	**5809**

Since in most cases fishing vessels operating in the area of the 14 fishing squares analysed, which are to be occupied to varying degrees by the OWF and its connection infrastructure, conduct fishing also in many other fishing squares, changing the location of fishing activities should not entail additional costs resulting from the need to identify fishing conditions at new fishing grounds. In 2014, in the area of the 14 squares analysed, the bottom-set gear and pelagic trawls were dominant in the catches. In the following years, the share of catches conducted using bottom-set gear gradually decreased, while the use of pelagic trawls changed, due to the high impact of individual fishing vessels on the overall fishing performance. In 2018, only 25% of fish were caught in the area of the fishing squares analysed using bottom-set gear, which was mainly due to the deteriorating condition of cod stocks (caught in this area mainly using bottom-set gear) (Table 7.4).

Table 7.4. Catch volumes in the years 2014–2018 in the area of the 14 fishing squares, where the OWFs and connection infrastructure will be located

Species / species group	**Volume of catches in years [t]**				
	2014	**2015**	**2016**	**2017**	**2018**
Cod *Gadus morhua*	922	1 018	868	447	439
European flounder *Platichthys flesus*	475	360	283	168	474
Herring *Clupea harengus*	425	986	274	985	370
Sprat *Sprattus sprattus*	70	170	176	103	483
Other	42	35	48	45	56
Total	**1934**	**2570**	**1649**	**1748**	**1822**

The movement of fishing vessels, which use bottom-set gear, may cause conflicts with the existing users of the fishing grounds, per which the number of gear used will increase. However, due to a significant reduction in the fishing capacity of the Polish fleet after the accession to the European Union and a significant deterioration in the status of cod stocks in the Southern Baltic, which resulted in the suspension of targeted catches of these fish in the East Baltic area in 2020. [Council Regulation (EU) 2019/1838 of 30 October 2019 fixing for 2020 the fishing opportunities for certain fish stocks and groups of fish stocks applicable in the Baltic Sea and amending the Regulation (EU) 2019/124 as regards certain fishing opportunities in other waters (OJ EU L 281 of 31 October 2019, p. 1−14)], it is not expected that there will be an excessive concentration (above the previously recorded) of bottom-set gear after the transfer of their volume from the area occupied by wind farms. In view of this, the cumulative negative impact of the relocation of the fishing fleet can be considered insignificant.

Extension of the route and travel time to the fisheries

The creation of a barrier to the free passage of fishing vessels shall constitute a negative impact of the presence of many OWFs in the neighbouring locations. The location of other wind farms of the National Fisheries Data Collection Programme east and west of the Baltic Power OWF, without leaving space for vessel movement, will extend the route of fishing vessels to productive fisheries located north of the OWF in the Słupsk Furrow area. This may result in additional costs, mainly for fishing vessels registered in the ports of Ustka (59 vessels) and Łeba (30 vessels), due to the increase in the amount of fuel and travel time to the fishery.

Figure (Figure 7.4) shows the OWF location in relation to the shortest routes to the fisheries in the area of the Słupsk Furrow and the routes to these fisheries potentially changed as a result of the OWF presence.

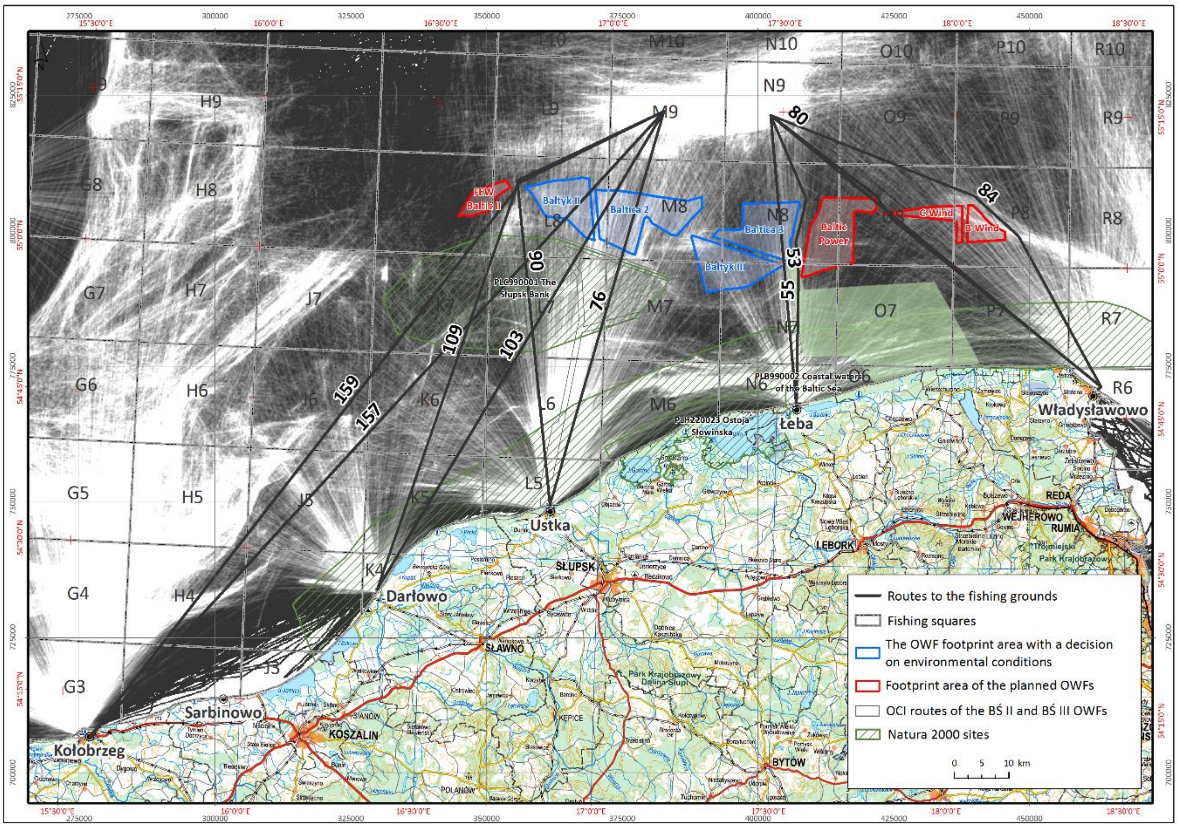

Figure 7.4. Existing and potentially extended routes to fisheries in the Słupsk Furrow area as a result of the presence of the OWF [Source: internal materials]

In order to calculate the estimated increase in the costs of conducting sea fishing, resulting from the necessity to bypass the OWF, the activity of fishing vessels departing from and returning to the ports in Kołobrzeg, Darłowo, Ustka, Łeba and Władysławowo was analysed. The calculations take into account the number of cruises conducted every year to the fisheries located north of the OWF. For the calculations, the central locations of fishing squares M9 and N9 were assumed as the target point of the fisheries. The number of fishing vessels operating in fishing squares was determined on the basis of the data from the logbooks and the register of fishing vessels: M9 for ports in Kołobrzeg, Darłowo and Ustka and N9 for ports in Łeba and Władysławowo. Only the cruises that began and ended at the same port were taken into account. Considering the above, the analysis takes into account the fishing activities of vessels routinely sailing through the OWF areas in order to fish in the Słupsk Furrow. On the basis of the RRW-19 questionnaire – Report on the financial conditions of fishing vessel, the average number of fishermen employed on a vessels was analysed. The average consumption of diesel oil at a level of 15 l/h was assumed for calculations (approximate data, information from the owner of the fishing boat K-15 KS type with a length of 17 m and motor power of 121 kW). The average cost of fuel per kW of engine power was calculated using average shipping fuel prices in 2017–2019 (PLN 2047, PLN 2505 and PLN 2505 per ton respectively). The cost of the additional working time of fishermen was calculated on the basis of the average monthly salary in the enterprise sector (PLN 4530, PLN 4852 and PLN 5169 respectively). The additional time that fishing vessels will need to bypass the OWF was calculated assuming an average vessel speed of 6 knots (11 km/h). The table (Table 7.5) presents the travel time and length of routes, by which access to the fishing grounds in the Słupsk Furrow area and return to the home ports of the fishing vessels, will be extended as a result of bypassing the OWF.

Table 7.5. Additional times and route lengths necessary to bypass the OWF on the way to and from the fisheries in the Słupsk Furrow area by the fishing vessels fishing from the ports of Kołobrzeg, Darłowo, Ustka, Łeba and Władysławowo

Port	Time [h]	Length [km]
Kołobrzeg	0.36	4
Darłowo	1.08	12
Ustka	2.52	28
Łeba	0.36	4
Władysławowo	0.72	8

The calculations performed on the basis of the data from 2017–2019 indicate that the necessity to bypass the OWF by fishing vessels sailing from and returning to the ports in Kołobrzeg, Darłowo, Ustka, Łeba and Władysławowo and fishing in the fisheries in the Słupsk Furrow area will result in the increase in fuel costs by approx. PLN 40 000 per year (Table 7.6). The extended time of travel and return from the fishery may generate additional labour costs of approx. PLN 111 000 per year. Due to the high significance of the fisheries in the Słupsk Furrow area to the fishermen with a home port in Ustka, as well as the largest extension of the route (by 28 km in both directions), fishermen from this port will bear the highest costs resulting from the necessity to bypass the OWF area. The estimated total increase in fuel costs and wages for this port will amount to approx. PLN 135 000, which constitutes approx. 90% of the total costs for all ports analysed (Table 7.6).

If the passage between the Baltic Power OWF and C-Wind is made available to fishing vessels, the way to the fishery for the fishing vessels sailing from Władysławowo will not be extended (Figure 7.4). In thas case, the total fuel costs resulting from the necessity to bypass the wind farms will amount to PLN 36 000 and the costs of extended working time will amount to PLN 106 000 (Table 7.7).

Table 7.6. Calculations of additional costs for fishery resulting from the bypassing of the OWF to the fishing grounds in the Słupsk Furrow

Year	Port	Number of vessels	Average number of crew	Number of cruises	kW cruises	Additional sailing time [h]	Additional working time [h]	Cost of 1 kWh [PLN]	Cost per man hour [PLN]	Additional cost of fuel [PLN]	Additional cost of labour [PLN]	Total [PLN]
2017	Darłowo	2	4.0	4	974	4	17	0.21	27	221	467	687
	Kołobrzeg	8	4.0	17	2616	6	24			198	661	859
	Łeba	12	4.0	192	24 590	69	276			1859	7447	9306
	Ustka	30	4.3	316	53 789	796	3454			28 465	93 269	121 735
	Władysławowo	30	4.9	68	19 324	49	248			2922	6687	9609
Total in 2017		**82**	**4.4**	**597**	**101 294**	**925**	**4020**	**0.21**	**27**	**33 665**	**108 532**	**142 196**
2018	Darłowo	1	3.4	5	350	5	18	0.26	29	98	532	631
	Kołobrzeg	9	4.0	10	1696	4	14			159	418	576
	Łeba	14	3.8	113	14 514	41	160			1359	4650	6008
	Ustka	29	4.3	283	53 609	713	3119			35 125	90 444	125 569
	Władysławowo	15	4.8	44	12 244	32	154			2292	4477	6769
Total in 2018		**68**	**4.3**	**455**	**82 413**	**795**	**3466**	**0.26**	**29**	**39 032**	**100 520**	**139 553**
2019	Darłowo	1	4.0	1	121	1	4	0.26	31	34	134	168
	Kołobrzeg	6	4.8	8	1993	3	13			187	411	597
	Łeba	11	3.8	99	10 730	36	139			1004	4306	5310
	Ustka	26	4.3	339	61 850	854	3736			40 524	115 821	156 345
	Władysławowo	7	5.0	33	9616	24	118			1800	3643	5443
Total in 2019		**51**	**4.4**	**480**	**84 310**	**918**	**4010**	**0.26**	**31**	**43 549**	**124 313**	**167 862**
Average		**67**		**511**	**89 339**	**879**	**3832**			**38 749**	**111 122**	**149 871**

Table 7.7. Calculations of additional costs for fishery resulting from the extension of the route to the fishing grounds in the Słupsk Furrow (taking into account the corridor between the Baltic Power OWF and the C-Wind OWF)

Year	Port	Number of vessels	Average crew	Number of cruises	kW cruises	Additional sailing time (h)	Additional working time (h)	Cost of 1 kWh (PLN)	Cost of labour (PLN/h)	Additional cost of fuel (PLN)	Additional cost of labour (PLN)	Total
2017	Darłowo	2	4.0	4	974	4	17	0.21	27	221	467	687
	Kołobrzeg	8	4.0	17	2616	6	24	0.21	27	198	661	859
	Łeba	12	4.0	192	24 590	69	276	0.21	27	1859	7447	9306
	Ustka	30	4.3	316	53 789	796	3454	0.21	27	28 465	93 269	121 735
Total in 2017		**52**	**4.2**	**597**	**81 970**	**876**	**3772**	**0.21**	**27**	**30 743**	**101 844**	**132 587**
2018	Darłowo	1	3.4	5	350	5	18	0.26	29	98	532	631
	Kołobrzeg	9	4.0	10	1696	4	14	0.26	29	159	418	576
	Łeba	14	3.8	113	14 514	41	160	0.26	29	1359	4650	6008
	Ustka	29	4.3	283	53 609	713	3119	0.26	29	35 125	90 444	125 569
Total in 2018		**52**	**4.1**	**597**	**69 819**	**757**	**3293**	**0.21**	**27**	**36 642**	**95 511**	**132 153**
2019	Darłowo	1	4.0	1	121	1	4	0.26	31	34	134	168
	Kołobrzeg	6	4.8	8	1993	3	13	0.26	31	187	411	597
	Łeba	11	3.8	99	10 730	36	139	0.26	31	1004	4306	5310
	Ustka	26	4.3	339	61 850	854	3736	0.26	31	40 524	115 821	156 345
Total in 2019		**43**	**4.3**	**597**	**74 573**	**893**	**3888**	**0.21**	**27**	**41 715**	**120 537**	**162 252**
Average		**49**		**597**	**75 454**	**842**	**3651**			**36 367**	**105 964**	**142 331**

Considering the above, the significance of the cumulative negative impact related to the necessity to extend the routes of fishing vessels to fishing grounds should be considered moderate. In order to limit the negative impact on fishery in this respect, an area of width necessary to maintain the safety of navigation should be left between the OWFs. In such a case, the significance of the project cumulative impact on fisheries may be considered insignificant. Another solution could be to allow the transit of fishing vessels through the Baltic Power OWF Area. The designation of navigation corridors or issuing the permission for the navigation through the Baltic Power OWF Area remain the sole responsibility of the competent Director of the Maritime Office.

8 Transboundary impact

The Baltic Power OWF Area is located in the Polish EEZ. The distances of this area to the boundaries of the EEZ of other countries are as follows:

- over 58 km from the Swedish Exclusive Economic Zone (EEZ);
- 100 km from the Danish EEZ;
- over 85 km from the Russian EEZ;
- over 189 km from the German EEZ.

The impact assessment conducted for individual elements of the environment indicates that their scope will be local. Only in three cases, the impact of the Baltic Power OWF has been identified as regional in scale. This refers to the impact of:

- underwater noise during the construction phase on adult fish;
- underwater noise during the construction phase on marine mammals;
- the barrier effect on birds during the exploitation phase.

The underwater noise analysis carried out for the purposes of the EIA Report both for fish and marine mammals showed that the ranges of significant impact, determined using TTS values, do not exceed the boundary of the Polish Exclusive Economic Zone.

With reference to the Convention on Environmental Impact Assessment in a Transboundary context, signed at Espoo on 25 February 1991 and the Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment, the transboundary impacts cannot be excluded for the Baltic Power OWF. Almost all species passing through this area are birds covering long distances between nesting sites and wintering grounds or birds moving locally. This means that the barrier effect and the risk of collision affect birds that spend at least part of their lives in north-west Russia and Scandinavia. Additionally, some of the species exposed to the impact are included in Annex I to the Birds Directive or included in the Natura 2000 protected areas program in the neighboring countries, and therefore, the impacts of the Baltic Power OWF may affect the abundance of birds which are the subject of protection in these areas.

Surveys carried out as part of the inventory of migratory birds for this project indicate that the impacts of the barrier effect and the risk of collision for the vast majority of species were considered negligible and insignificant. The significance of the barrier effect at the level of a single OWF was assessed to be negligible for all species. The transboundary impact was considered to be the same (in several cases it was considered to be of little importance). The bird mortality increased as a result of collisions with the OWF from the transboundary point of view will be an undetectable part of the total mortality (natural and related to human activity) for most species. The moderate significance of the risk of collision in the case of the crane will not affect the population of cranes nesting and wintering in other Baltic countries (the mortality threshold of cranes with which the biogeographical population can cope and remain in good condition is 1887 specimens per year [103]) and will be negligible or insignificant when mitigation measures shall be applied (periodic shutdown of individual turbines during intensive passages of cranes). The predicted mortality resulting from collisions will not pose a threat to the population, which will be able to compensate for the lost specimens as a result of the project impact. In the case of a larger number of neighbouring OWFs in this area of the Baltic Sea, the accumulated mortality may theoretically exceed the above-mentioned mortality threshold which allows to maintain the population in good condition, but this will depend to a large extent on the mitigation measures applied in other projects in the vicinity of the Baltic Power OWF. An important element in the context of all OWFs in this area, which reduces the risk of collision, is the creation of a system of corridors (areas free of development) enabling free movement of birds between individual OWFs. Such a solution has been proposed for the Baltic Power OWF. Corridors were indicated both on the western and eastern side of the Baltic Power development area, which in connection with the corridor between the Baltica 2 and Baltica 3 OWFs create a free space for bird movement. The application of the system for shutting down the elements of the Baltic Power OWF will additionally allow to minimise the impact of this project on the migration of cranes.

The OWF Area is a place of periodic (winter season) concentration of the long-tailed duck, the velvet scoter, the razorbill and the European herring gull, as well as the common guillemot in the summer period. Supplementary surveys carried out in 2020 indicated that birds wintering in this part of the Baltic Sea move locally in all directions without a clear pattern during short feeding flights. This is confirmed by the rule that seabirds show strong attachment to a wintering ground [197, 217, 309]. In a transboundary context, the results of modelling of the avifauna abundance in the Baltic Power OWF during the wintering period and the data from literature on the size of their Baltic Sea population were compared and presented in the table (Table 8.1).

Table 8.1. Comparison of the abundance of birds wintering in the OWF Area and the Baltic Sea area [Source: Baltic Power Sp. z o.o. data]

Species	Baltic Power OWF	Baltic population
Long-tailed duck *Clangula hyemalis*	857	1 500 000[1)]
Velvet scoter *Melanitta fusca*	83	373 000[1)]
Razorbill *Alca torda*	75	155 000[2)]
European herring gull *Larus argentatus*	117	no data
Total	1238	-

[1)] *source: HELCOM 2013 [176]*

[2)] *source: Chylarecki et al., 2018 [78]*

Compared to the Baltic Sea population, the size of the OWF Area population of the long-tailed duck is 0.06%, the velvet scoter − 0.02%, and the razorbill − 0.04%. There is no data on the size of the Baltic population of the European herring gull. However, since these birds accompany fishing boats at fisheries, their occurrence in the open sea is strongly dependent on human activity. Therefore, no significant transboundary impacts will occur. Thus, no transboundary impacts are expected from a single project consisting in the construction of the Baltic Power OWF.

9 Analysis and comparison of the variants considered and the variant most favourable for the environment

Issues related to project options, including descriptions and comparison of technical parameters of the two analysed options, i.e. the Applicant Proposed Variant (APV) and the Reasonable Alternative variant (RAV), are included in the subsection 2.3. Taking into account the specificity of the planned project, including in particular the site selection decision issued (PSzW No. MFW/6/12, as amended), it would be unjustified to include another place of the Baltic Power OWF implementation in the RAV. Therefore, both the APV and the RAV were considered for the same area.

The main differences between the APV and the RAV were based on the existing and the technological solutions feasible in the coming years, resulting from the intensive development of offshore wind energy. The maximum installed power of the Baltic Power OWF, i.e. 1200 MW, indicated in the PSzW No. MFW/6/12, as amended, was adopted as the limit parameter in both options considered. Therefore, with the use of higher power turbines, it becomes possible to erect a smaller number of wind power stations.

The RAV assumes 5 MW turbines for the analyses. Taking into account the maximum installed power of the Baltic Power OWF, in this option it would be necessary to construct 240 wind turbines. With the turbine power output of 9.5 MW assumed in the APV, the maximum installed power will be achieved already after the construction of 126 wind power stations.

Construction and exploitation of a smaller number of wind power stations as part of the APV in relation to the RAV, means, consequently, less interference with the environment as a result of:

- shorter duration of the construction and decommissioning phases;
- lower number of risky lifting and offshore operations;
- lower consumption of construction materials and consumables.

Also during the OWF exploitation phase, a smaller number of wind power stations as part of the APV will require a smaller number of maintenance and operation activities in relation to the RAV, and consequently it will contribute to a smaller environmental impact.

The use of wind power stations with higher power output in the APV may necessitate the use of larger foundations or supporting structures.

In both cases, i.e. as regards the size of foundations or supporting structures and the size of rotors, it was assumed that in the case of wind power stations with a higher power output they will be larger in the APV. Such an assumption results from a prudential approach. However, it cannot be excluded that wind turbines with a higher power output will not require an increase in the physical parameters of individual structural elements of the wind turbines in the future, which may additionally reduce the significance of environmental impacts of the Baltic Power OWF APV in relation to the RAV.

A significant difference indicating that the APV compared to the RAV will have a smaller impact on the environment is the issue of the risk of migratory birds colliding with the wind power station structures. The results of collision modelling indicate that in most cases this risk is higher for the RAV and in no case is it lower. Given the long-term nature of this impact (several decades of exploitation are assumed), these differences are an important reason to indicate that the APV is a more environmentally advantageous option than the RAV.

To sum up the above considerations, it should be stated that the main parameters differentiating the two variants analysed are the number of wind power stations and the rotor diameter. In consequence, they determine the size of the impact on individual elements of the environment.

Comparing both options, including, in particular, the resulting possible environmental impacts, it should be indicated that the APV is the most beneficial option for the environment.

10 Comparison of the technological solutions proposed with the technological solutions meeting the requirements referred to in Art. 143 of the Environmental Protection Law

Pursuant to Article 143 of the Act of April 27, 2001 – Environmental Protection Law (Journal of Laws of 2001, No. 62, item 627, as amended), the technologies used in newly commissioned systems should meet the requirements which consider, in particular:

- the use of substances with a low hazard potential;
- the effective generation and use of energy;
- ensuring rational consumption of water and other raw materials as well as materials and fuel;
- the use of waste-free and low-waste technologies and possibility of waste recovery;
- indication of the type, range and size of emissions;
- the use of comparable processes and methods which have been effectively applied on industrial scale;
- scientific and technical progress.

This catalog of requirements refers to newly commissioned industrial systems and equipment which are a source of environmental hazards. Due to the process specificity of the construction, exploitation and decommissioning phases as well as the special conditions of operation in the marine environment, offshore wind farms require verification of these requirements at an early stage of project planning.

The structural elements of the OWF shall be made of materials neutral to sea water and soil substrate (seabed). Resistance to erosion, corrosion or chemical compounds that may appear in water is the basic condition for failure-free operation of the OWF.

Efficiency of energy generation will be one of the basic criteria for the selection of OWFs and their distribution, as well as the method of transmission of energy generated from the OWF to the National Power System with reduced transmission losses. The primary criterion of energy efficiency is its generation, with obvious limitations related to the wind speed of the sea area, without the use of energy raw materials – in a fully renewable manner.

In the case of this type of renewable energy sector, the actual efficiency of energy use involves non-returnable energy consumption for the production of OWF components (wind power stations and other facilities) and their installation at sea.

The consumption of water, materials, raw materials and fuels will take place during the construction process (installation of subsequent wind power stations and laying submarine cables) and during the decommissioning of OWF elements after their loss of technical usefulness. During 20−30 years of operation, the wind power stations will require the use of consumables and fuels during service activities.

Emissions and their range will mainly relate to acoustic impacts accompanying the operation of wind power stations. They will not have a significant impact on marine organisms or cause noticeable electromagnetic impacts.

Experience regarding the use of wind power stations within the Baltic Sea enables the installation of the most efficient and proven solutions meeting the requirements of the most advanced technologies, resistant to the conditions of operation in the marine environment with a highly variable wind speed.

11 Description of the prospective actions to avoid, prevent and reduce negative impacts on the environment

The environmental impact assessment carried out for the Baltic Power OWF shows that there will be no significant negative impacts as a result of this project implementation. Nevertheless, impacts of lesser significance are unavoidable. Hence, the rational measures to avoid, prevent and limit negative environmental impacts resulting from the implementation of the Baltic Power OWF project, are presented below broken down into individual phases.

The mitigation measures proposed for the construction phase include:

- beginning of piling using the so-called soft-start procedure to allow fish, birds and marine mammals to leave and move away from the work site region;
- piling carried out in the period from August to March under the supervision of ornithologists. If the ornithological supervisors do not observe the presence of the common guillemots, razorbills, long-tailed ducks and velvet scoters in the area with a radius of 2 km from the piling site, the work may begin, preceded each time by the soft-start procedure [253, 345, 242];
- building further power stations beginning from one location, so that the sea area designated for the project is filled with structures gradually, extending the OWF Area by the adjacent power stations;
- simultaneous piling in a maximum of two locations (to reduce noise), regardless whether the two sources are located within the Baltic Power OWF Area or one of them is in the area of another, neighbouring OWF;
- intensification of the pace of construction works in the months of March−September, when the number of birds in this sea area is the lowest;
- limiting sources of strong light directed upwards at night; this mainly concerns the periods of bird migration. The Applicant declares that they will limit the light emission to the necessary level, resulting from the applicable regulations and work safety standards.

The mitigation measures proposed for the exploitation phase include:

- painting the blade tips bright colours, which should increase the likelihood of the operating wind power station being noticed by the flying birds. The Applicant declares that the painting of the blade tips will be carried out in accordance with the industry standards and will be agreed with the appropriate authorities;
- illumination of the power stations during night-time conditions through the installation of small, weak and pulsating light sources. Constant, bright lights and pulsating white lights increase the risk of collision. It is also proposed to change the lighting during the limited visibility conditions from continuous to pulsating lighting with a long interval. The Applicant declares that they will limit the light emission to the necessary level, resulting from the applicable regulations and work safety standards;
- equipping OWF with a system allowing for a short-term shut-down of selected wind turbines during bird migration periods in the case when the results of operational monitoring indicate that an intensive migration of cranes at the collision height takes place over the OWF Area;
- abandonment of the use of lattice structures of wind power station towers (not applicable to foundations or supporting structures), due to the greater probability of collisions between birds and the power stations of such structure (less visible to birds from a longer distance).

The mitigation measures proposed for the decommissioning phase include:

- the removal of subsequent power stations beginning from one location, so that the sea area occupied by the OWF is cleared from the structures gradually;
- maximising the pace of dismantling works in the months of March−September, when the number of birds in this sea area is the lowest.

12 Proposal for the monitoring of the planned project impact and the information on the results available for another monitoring, which may be important for establishing the responsibilities in this field

Pursuant to the Art. 66 of the EIA Act a proposal to monitor the impact of the planned project in its construction and exploitation or use phases is presented in this section, in particular, the impact on the forms of nature protection, referred to in the Art. 6, paragraph 1 of the Act of 16 April 2004 on the nature conservation (Journal of Laws of 2004, No. 92, item 880 as amended), including the objectives and the subject of protection of the Natura 2000 site, and the continuity of the wildlife corridors connecting them, as well as the information on the available results of other monitoring, which may be important for establishing responsibilities in this area.

12.1 Proposal for the monitoring of the planned project impact

Due to the length of the construction process (about 2–8 years) and the possibility of a staged introduction of particular parts of the OWF into operation, and hence, the overlapping of the construction and exploitation phases, the schedules of individual monitoring surveys have been described in a continuous manner, indicating three clear points of the project implementation:

- the beginning of construction – understood as the first activities in the Baltic Power OWF Area related to its construction;
- the beginning of exploitation – understood as the opening of the first stage of the Baltic Power OWF, after which the energy generated at the Baltic Power OWF will be transferred to the NPS, a phase that may overlap with the ongoing construction works on the remaining parts of the Baltic Power OWF;
- the completion of construction – understood as the end of all construction works in the Baltic Power OWF Area and the moment when the project consisting in the construction of a wind power stations in full capacity begins to supply the NPS with the energy produced by all power stations installed.

The monitoring surveys methodologies will be presented to the Regional Director for Environmental Protection to be agreed before the beginning of the surveys.

12.1.1 Underwater noise monitoring

The monitoring of underwater noise will be conducted during the construction phase. The underwater noise caused primarily by the piling of wind power station foundations or supporting structures, was defined in the EIA Report as a factor that could have a negative impact on the marine organisms under evaluation i.e. birds, fish and mammals.

The place of underwater noise measurement will be the boundary of the Natura 2000 site Ostoja Słowińska (PLH220023), where due to the presence of fish and marine mammals, which are the subject of protection of this area, the permissible level of underwater noise cannot exceed: for fish 186 dB re 1 μPa^2s SEL_{cum}, for porpoises 140 dB re 1 μPa^2s SEL_{cum} and weighted by the HF function (HF weighting function for marine mammals with high sensitivity to high frequency sounds [297]), for seals 170 dB re 1 μPa^2s SEL_{cum} and weighted by the PW function (PW weighting function for pinniped marine mammals [297]). The location of the noise detection stations will be determined so that it is possible to assess the level of underwater noise at the boundary of the Natura 2000 site Ostoja Słowińska (PLH220023) for the work performed in the Baltic Power OWF Area. Noise measurements will be performed using hydrophones calibrated in the frequency range of 10 Hz–20 kHz.

The results of the underwater noise monitoring will be forwarded to the Regional Director for Environmental Protection in the form of periodic reports. In the case of the indication of the above-mentioned noise levels exceedances, the actions preventing or minimizing these impacts will be proposed together with an indication of the methods of their implementation and control of the results.

12.1.2 Ichthyofauna monitoring

The monitoring of ichthyofauna will be carried out during the OWF exploitation and after its decommissioning.

During exploitation, the long-term artificial reef effect on the abundance and taxonomic composition of fish, including the presence of early developmental stages of fish such as larvae and fry, and the potential colonisation by invasive species will be assessed.

In addition, it must be examined, whether the artificial reef effect is limited to attracting fish from a nearby sea area to this area or whether a real increase in productivity is found.

In the event of the decommissioning of the OWF, the degree of changes that will occur after the destruction of the artificial reef, potentially constituting a habitat, feeding ground, shelter and a breeding ground for many fish species, will be assessed.

The surveys should be conducted in the spring and summer periods, one year and 5 years after the construction was completed and one year after the decommissioning phase. A set of research tools in the form of multi-mesh gillnets and, in the case of early developmental stages, a Bongo net for sampling ichthyoplankton should be used. Survey stations should be designated both in the OWF Area and at a certain distance from it, in an area not intended for offshore energy production, but characterised by similar parameters of the marine environment (depth, distance from the shore, etc.).

The result of the monitoring will be important when determining possible measures to prevent or minimise the impact of, mainly, anthropopressure (commercial and recreational fishing).

The detailed methodology of the post-investment monitoring will be possible to be developed after the final shape of the planned project has been approved and the schedule of the construction works has been presented by the Investor.

12.1.3 Migratory birds monitoring

The post-investment monitoring of birds should include radar monitoring as well as visual observations during daytime. Radar surveys should be focused on the trajectory of birds flying towards the OWF and their response to a barrier in the form of the OWF, as well as on the determination of the intensity of migration in the OWF Area and its immediate vicinity, to enable a comparative analysis with other surveys in this regard which are available and to provide new data to analyse the barrier effect and the avoidance frequency (birds turning back). Radar surveys should be carried out during the migration periods, in the months from March to May and from the end of July to mid-November. Optimal post-investment monitoring should consist of simultaneous visual, radar and acoustic observations (at night, to identify species) allowing for the identification not only of the direction of flight and reaction, but also of the species. A survey station should be located on a fixed platform (OWF power station) or an anchored vessel and should allow observing the OWF from the direction from which birds arrive during a given migration stage, i.e. in spring, it should be located at the south-western edge of the OWF, and in autumn, at the north-eastern edge of the OWF. In each of the migration seasons, no less than 20 days of observation should be carried out in 2- to 5-day sessions, spaced evenly over the migration season. Taking into account the experiences from similar projects in the Baltic Sea and the North Sea [*i.a.* 27, 202, 381], we propose that the monitoring of migratory birds is conducted in two cycles per year, resulting from two bird migration periods, i.e. from March to May and from July to November, in 4 monitoring blocks:

- 2 cycles of surveys during migration periods, 4 years after the beginning of exploitation (due to the possibility of the continuation of construction for more than 4 years from the beginning of exploitation and the need to verify the assessment assumptions);
- 2 cycles of surveys during migration periods in the first year from the completion of construction.

12.1.4 Seabirds monitoring

Pre-investment monitoring (before construction begins)

Pre-investment monitoring of the OWF regarding seabird surveys should include the daytime counting of birds present in the OWF Area and in a reference area.

The route of the survey cruise should be delineated so as to cover the 5-kilometre zone around the boundaries of the OWF and to enable the assessment of the changes in the density of birds staying at different distances from the future power stations. These surveys must first and foremost cover the period of the greatest abundance of birds in the Southern Baltic, thus, they should last from October to May with a frequency of not less than 1 cruise a month. In the remaining months, the abundance of birds in the Baltic Power OWF Area is low, therefore, in the summer period it is enough to carry out two survey cruises, one in August and one in September. The dates of survey cruises should be synchronised so that counting in both sea areas is performed simultaneously.

The surveys should be conducted one year before the beginning of the OWF construction.

The detailed methodology of the pre-investment monitoring will be possible to be developed after the final shape of the planned project has been approved and the schedule of the construction works has been presented by the Investor. In particular, this applies to the possibility of designating a reference survey area, which can be determined on the basis of the PMA spatial development plan. This will allow for the designation of a reference survey area in sea areas not intended for offshore wind energy production, but characterised by similar parameters of the marine environment (depth, distance from the shore, etc.). Moreover, only after the construction design has been developed, it will be possible to designate the course of bird count transects in the OWF Area, in a way to meet the condition of conducting the surveys at different distances from a power station.

Construction phase

There is no need to monitor the impact of the planned OWF on seabirds during the construction phase.

Exploitation phase

Post-investment monitoring of the OWF regarding seabird surveys should include the counting of birds present in the OWF Area and in the reference area conducted during the day.

The survey cruise route should be the same or very similar to that in the pre-investment monitoring (before the construction begins). These surveys must first and foremost cover the period of the greatest abundance of birds in the Southern Baltic, thus, they should last from October to May with a frequency of not less than 1 cruise a month (optimally two cruises per month). In the remaining months, the abundance of birds in the Baltic Power OWF Area is low, therefore, in the summer period it is enough to carry out two survey cruises, one in mid-August and one in mid-September. The dates of survey cruises should be synchronised so that counting in both sea areas is performed simultaneously.

The surveys should be conducted for 2 consecutive years (the first 2 years of the OWF exploitation phase), if the construction will not be staged. Otherwise, these surveys should be performed after the first construction phase is completed and after the entire OWF is completed. During the first season, birds will gradually become acclimated to the situation in which the sea area designated for the project becomes inaccessible to them (the so-called habituation), which will result in changes in their distribution. Therefore, this period can be treated as a transitional one and only in the second year the scale of the Baltic Power OWF impact on the seabirds residing in this area will stabilise.

The detailed methodology of the post-investment monitoring will be possible to be developed after the final shape of the planned project has been approved and the schedule of the construction works has been presented by the Investor.

12.1.5 Marine mammals monitoring

Due to a very low number of porpoise detections, any monitoring to investigate the impact of an OWF construction phase is difficult. Monitoring should be performed using C-POD devices.

At least 5 C-POD devices should be located in the planned OWF Area, preferably at the same stations as during the pre-investment monitoring. In addition, 5 C-POD devices should be placed in a gradient system covering an area of not less than 20 km outside the impact zone (the zone of behavioural reactions to piling), an example provided in Brandt *et al.* [60].

The gradient system requires the classification of samples according to the distance and eliminates the question of selecting a control site [22]. It is also more effective than randomly selecting checkpoints to detect changes caused by noise. It has been proven to be more effective in surveys on the movement of porpoises due to piling and in studying the differences in the momentary impacts depending on distance [91].

Porpoise monitoring should start not later than 6 months before the planned construction works, and last over the entire construction phase and at least 2 years after its completion.

12.1.6 Benthic organisms monitoring

Due to the occurrence of negative impacts on benthic complexes during the OWF construction and exploitation phases, monitoring of these organisms should be carried out. The issue of the colonisation of artificial hard substrates by animal and plant periphyton complexes is presented in subsections 6.1.2.6.1.1 and 6.1.2.6.1.2. An important strategy of monitoring surveys is the possibility of comparing the results of these surveys with the results of inventory surveys, therefore, they should be planned in similar seasons. Due to the lack of standard, commonly used guidelines for the implementation of this type of surveys in PMA, an original monitoring methodology has been proposed, based primarily on the life cycle of benthic organisms in the Southern Baltic. The proposal for benthos monitoring in terms of dates and frequency of surveys was also developed on the basis of the literature on the subject [238, 385], while the one regarding the methodology of testing benthic organisms samples on the basis of the methodological guide [238].

The benthos monitoring program in the OWF Area concerning surveys on periphyton flora and fauna will be carried out on 5 underwater structural elements of wind power stations and the accompanying infrastructure.

At each object surveyed, a video and photographic documentation of the entire section covered with macroalgae and periphyton fauna will be made (note: the depth of the periphyton flora occurrence may differ from the extent of the periphyton fauna occurrence). Beginning from the water surface to the depth of the maximum range established for the periphyton organisms occurrence, at particular depths, within a maximum interval of 2 m, samples from a specific area will be collected by a scuba diver or an ROV for the surveys on taxonomic composition and biomass of periphyton flora and fauna. The surveys will be carried out once a year in June. For the first time, the surveys should be conducted when at least 3 months have passed since the completion of the construction of the wind farm selected for monitoring. Subsequent surveys should be carried out 2 and 4 years after the first surveys. The last surveys should be conducted one year before the planned disassembly of the wind farm.

As part of the monitoring surveys of benthos, also macrozoobenthos surveys will be carried out on 5 foundations or supporting structures of wind power stations selected to represent possible construction stages (structures erected at different stages) and different parts of the OWF Area. In the vicinity of a single foundation or supporting structure, 6 stations should be designated, including 3 stations on the main profile transect (along the near-seabed current axis) at a distance of 20, 50 and 100 m from the foundation or supporting structure, and 3 stations on the transect perpendicular to the main profile (reference profile) at the same distances. The surveys will be carried out after the construction of the structures selected for monitoring has been completed, once in a period similar to the period of inventory surveys (May–June). The first surveys should be carried out within the period indicated after the completion of construction, and the following ones, 2 and 4 years after the first surveys. The last surveys should be conducted one year before the planned disassembly of the wind farm.

12.1.7 Bats monitoring

The purpose of a post-implementation monitoring is to verify the assessment assumptions in terms of changes in the use of the OWF Baltic Power Area by bats. Monitoring as part of the post-implementation surveys should include the monitoring of bats' activity – determining the species composition and abundance. The equipment used should enable automatic registration and meet the minimum equipment requirements applied in the pre-investment surveys. The devices can be mounted e.g. on the mast of a survey station [329].

Post-implementation monitoring should cover the period of 3 years, in the first year after the wind power station was put into operation and in the second and third years of the OWF operation. The monitoring should cover the spring (April-May) and autumn (August-October) migration periods.

Due to the lack of technological solutions enabling the performance of reliable surveys of bat mortality and collisions, the above requirement, imposed by the proposed guidelines, should be abandoned [213].

12.2 Information on the results available for another monitoring, which may be important for establishing the responsibilities in this field

The environmental monitoring of the Polish part of the Baltic Sea is carried out as part of the State Environmental Monitoring (SEM). This monitoring includes the surveys of the following parameters:

- physico-chemical: temperature, salinity, oxygen concentration, Secchi disc visibility, content of nutrients, heavy metals and persistent organic pollutants;
- biological: phytoplankton, zooplankton, phytobenthos and macrozoobenthos.

The level of harmful substances in the water and in marine organisms as well as the content of radionuclides in the water and in sediments are also monitored. In addition, ichthyofauna and optional microbiology surveys are carried out, as well as the surveys of hydrographic conditions, waste in the marine environment and underwater noise (SEM Program, 2015). The results of this monitoring are collected and stored in the Oceanographic Database at the Gdynia Maritime Branch of the IMWM-NRI and in the "ICHTIOFAUNA" database at the Chief Inspectorate for Environmental Protection in Warsaw (SEM Program, 2015).

Moreover, since 2015, the Monitoring of Marine Habitats and Species has been carried out to include the monitoring of 8 species of fish and lampreys (sea lamprey, river lamprey, twaite shad, asp, weatherfish, spined loach, sabrefish and European bitterling), 4 species of marine mammals (harbour porpoise, grey seal, harbour seal and ringed seal) and 5 natural habitats connected to marine areas (Sublittoral sandbanks (1110); Estuaries (1130), Coastal lagoons (1150); Large shallow inlets and bays (1160) and Boulder areas and rocky reefs, Reefs (1170)). The results of the Monitoring of Marine Habitats and Species are collected and made available by the Chief Inspectorate for Environmental Protection in Warsaw.

Within the framework of SEM, as part of the task entitled "Bird monitoring including Natura 2000 Special Protection Areas", a number of bird monitoring surveys is carried out, which may be important for establishing the obligations of monitoring the impact of the planned project, including (SEM, 2015):

- the Flagship Bird Species Survey, covering the monitoring of twelve bird species with the characteristics of the so-called flagship species such as, the mute swan, red-necked grebe, black-necked grebe, Eurasian bittern, grey heron, white stork, western marsh harrier, common crane, black-headed gull, common tern, black tern and rook;
- the Monitoring of Wintering Seabirds (MSW), covering the monitoring of species of average abundance and abundant species of anseriformes wintering in the Polish zone of the Baltic Sea, including basic species (red-throated diver, black-throated diver, horned grebe, red-necked grebe, long-tailed duck, velvet scoter, common scoter, black guillemot, razorbill and common guillemot) and additional species (great crested grebe, European herring gull, great black-backed gull, common gull and black-headed gull).

The results of these monitoring surveys are also collected and made available by the Chief Inspectorate for Environmental Protection in Warsaw.

The Ministry of Maritime Economy and Inland Navigation collects data on the volume of fish catches carried out in PMA. The analysis of these data will enable in the future the assessment of the planned project impact on fisheries.

In the long term, for which the implementation of the Baltic Power OWF is planned, the survey results obtained as part of the monitoring conducted and the information on other activities carried out in the sea areas can be used to monitor the project impact on the environment. This is due to the fact that the scope of these monitoring surveys and information cover those elements of the marine environment which the planned project may affect directly and indirectly. In addition, the lengthy series of surveys, will allow to eliminate from the assessment the short-term changes in the environment resulting from the complex marine ecosystem characteristics, and not being a consequence of the planned project impact.

13 Limited use area

The issue of establishing a limited use area (LUA) is regulated by the provisions of Article 135 section 1 of the Environmental Protection Law: *If the environmental review or the environmental impact assessment required under the provisions of the Act of 3 October 2008 on the access to information on the environment and its protection, public participation in environmental protection and on environmental impact assessments or the post-implementation analysis show that, despite the application of technical, process and organisational solutions available, the environmental quality standards outside the premises of the plant or other facility cannot be met, then a limited use area is created for a wastewater treatment plant, municipal waste landfill, composting plant, communication route, airport, power line and substation as well as a radiocommunication, radio navigation and radiolocation system.*

Two out of the above-mentioned tasks, to be performed as part of the planned project, i.e., power lines and substations as well as radiocommunication, radio navigation and radiolocation systems, may require an establishment of a LUA.

The validity of establishing a LUA with respect to the planned OWF should be examined by analysing whether the environmental quality standards cannot be met outside the area of the planned OWF in the meaning of a plant as defined in Article 3 section 48 of the Environmental Protection Law: *a plant shall mean one or more systems together with the land to which the plant operator holds a legal title, and with the equipment located thereon.*

This EIA Report indicates that at the current stage of project preparation, there are no grounds to determine the possibility of exceeding the environmental quality standards either in relation to air, noise, wastewater or the EMF – the intensity of the magnetic field and the electric field will not exceed the permissible values outside the area to which the Applicant holds a legal title. The nearest areas for which environmental quality standards were specified in the aforementioned scope are located onshore, at a distance of over 23 km from the planned project.

14 Analysis of possible social conflicts related to the planned project, including the analysis of impacts on the local community

It should be assumed that the period of informing about the planned Baltic Power OWF is 2011 and the following years, when:

- the Applicant submitted a request for issuing the PSzW and obtained the Decision of the Minister of Transport, Construction and Maritime Economy No. MFW/6/12 of 9 May 2012 on the permit for the construction and use of artificial islands, structures and devices in the Polish Maritime Areas for the project named „Zespół Morskich Farm Wiatrowych o maksymalnej łącznej mocy 1200 MW oraz infrastruktura techniczna, pomiarowo-badawcza i serwisowa związana z etapem przygotowawczym, realizacyjnym i eksploatacyjnym" [literally: "Offshore Wind Farms Complex with a maximum total power output of 1200 MW together with technical, research and measurement, and service infrastructure related to the preparatory, construction and exploitation stages"];
- the basic documents defining the spatial policy of the country and region have been adopted:
  - „Polityka energetyczna Polski do 2030 roku" [the Polish Energy Policy until 2030] adopted by the Resolution of the Council of Ministers No. 201/2009 of 10 November 2009;
  - „Polityka Morska Rzeczypospolitej Polskiej do roku 2020 (z perspektywą do 2030 roku)" [literally: the Maritime Policy of the Republic of Poland until 2020 (with an outlook until 2030)] (Ministry of Infrastructure, Warsaw 2015) prepared by the Interministerial Team for the Maritime Policy of the Republic of Poland on the basis of the document „Założenia polityki morskiej Rzeczypospolitej Polskiej do roku 2020" [literally: Assumptions of the Maritime Policy of the Republic of Poland until 2020] of 14 September 2009;
  - „Koncepcja Przestrzennego Zagospodarowania Kraju 2030" [literally: the National Spatial Development Concept 2030] adopted by the Resolution No. 239 of the Council of Ministers of 13 December 2011;
  - On 15 November 2013, the Director of the Maritime Office in Gdynia, the Director of the Maritime Office in Słupsk and the Director of the Maritime Office in Szczecin announced the instigation of the planning process, with the aim to develop a draft "Spatial Development Plan for the Polish Maritime Areas". The planning process includes the preparation of the Study of Conditions for the Plan and the Spatial Development Plan for the Polish Maritime Areas; in 2015, the preparation of the Spatial Development Plan for the Polish Maritime Areas together with spatial analyses was completed. The draft plan was prepared in 2019 and is expected to be implemented in 2021;
  - „Strategia Rozwoju Województwa Pomorskiego 2020" [literally: Pomeranian Voivodship Development Strategy 2020] adopted by the Resolution No. 458/XXII/12 of the Pomeranian Voivodship Parliament of 24 September 2012;
  - „Regionalny Program Strategiczny w zakresie energetyki i środowiska. Ekoefektywne Pomorze" [literally: Regional Strategic Program for the Energy and the Environment. Eco-efficient Pomerania] adopted by the Resolution No. 931/274/13 of the Government of the Pomeranian Voivodship of 8 August 2013;
  - „Plan zagospodarowania przestrzennego województwa pomorskiego 2030" [literally: Pomeranian Voivodship Spatial Development Plan 2030] adopted by the Resolution of the Pomeranian Voivodship Parliament No. 318/XXX/16 of 29 December 2016 on the adoption

of a new Pomeranian Voivodship spatial development plan along with a spatial development plan for the Tricity metropolitan area constituting a part of the former.

According to the aforementioned permit and the provisions of planning documents, the implementation of offshore wind energy constitutes an element of the National Power System.

Draft strategy documents together with environmental impact forecasts were subject to a public participation procedure, together with social consultations conducted by competent administrative authorities prior to their adoption in accordance with the provisions of the Act on spatial planning and management.

The starting point for the public consultations on the planned OWF were national and EU legal requirements, which indicate that planned projects that may have a significant impact on the environment, and the construction of offshore wind farms can be considered as such, should be consulted with the public at the earliest possible stage, to find out the opinions of the interested people and local communities, in order to identify potential problems and determine the methods of solving them as well as to provide information to interested groups or people.

The planned OWF is located in the Baltic Sea within the Polish Exclusive Economic Zone (EEZ), north of the seashore, at the height of Rowy-Łeba towns, at a distance of approx. 23 to 36 km from the shore. The nearest seaports are Łeba and Władysławowo in the Pomeranian Voivodship. The regional, on- and offshore nature of the project means a wide range of potential stakeholders and interested entities from the northern part of the Pomeranian Voivodship and other interested parties.

The target groups for conducting information meetings were selected taking into account a number of criteria such as, the nature of the project, its location, potential impacts of the planned project, and the degree and type of interest of various social groups identified during other investments at sea.

The planned OWF will be located in a sea area exploited and used by people, therefore, it can be expected that the implementation and exploitation of the project, and above all the exclusion or limitation of the existing use as well as the difficulties resulting from the establishment of transport corridors, will potentially cause social conflicts. The possibility of using the sea area and safety zone as well as other restrictions will be determined in the future by the Director of the Maritime Office in Gdynia. Considering the nature of the OWF, it was considered probable that this may apply to fisheries and shipping within the OWF region.

The following aspects related to the planned OWF, which may cause social conflicts, were identified:

- construction and transport of large-size marine structures;
- concern about the environmental conditions in the Baltic Sea, issues of broadly understood nature and bird protection;
- concern of the current and potential users of the OWF Area about the possibility of access to this sea area, concern about workplaces, e.g., related to fisheries, ensuring proper functioning of communication systems;
- concern about navigation restrictions and their nature in the OWF Area;
- landscape aspects, visibility of the OWF;
- concerns for the impact on tourism in coastal municipalities;
- concerns for the impact on the economy in coastal municipalities.

Potential positive changes that may be caused by the planned OWF were also identified:

- workplaces for residents of coastal municipalities at the stage of construction and long-term exploitation of the OWF;
- impact on tourism and perception of the OWF as a tourist attraction.

The potential conflict concerning the planned OWF is underpinned by the following issues:

- depending on the decisions of the maritime administration, difficulties for the fisheries in the sea area occupied by the OWF, resulting in a limitation of access to it, and therefore, hindering free fishing and transit through the OWF Area, can be expected;
- incompatibility of the objectives and interests of the parties – the objective indicated by the fishermen community is fishing and transit through the OWF Area to further fishing grounds, as well as ensuring the presence of fish in the Baltic Sea;
- disturbance in the environment that may result from the planned OWF.

The potential stakeholders (target groups) are:

- administration and state institutions;
- local government units and institutions;
- trade organisations, including fishing organisations;
- national, regional and local social associations and organisations;
- non-governmental environmental organisations;
- potential suppliers, partners, other investors at sea;
- scientific, research and design units.

Due to the location and scope of the tasks of the planned OWF and the direct users of the sea in this area at the current early stage of the project preparation, the Applicant decided to hold information meetings with the representatives of fishermen organisations. As part of the preparation of this Report, information meetings were held with the representatives of fishermen organisations in March 2020. Formal consultations will be carried out as part of the environmental impact assessment procedure conducted by the Regional Director for Environmental Protection in Gdańsk. Two information meetings were held: on 5 March 2020 in Łeba and on 6 March 2020 in Władysławowo. Presentations and information materials were prepared.

The participants of the consultation meetings pointed out a wide variety of issues, including environmental issues. The results of the consultations were used in the preparation of this EIA Report for the OWF.

The main conclusions of the information meetings held in 2020 were as follows:

- the participants raised the issue of occupying the fishing grounds by the OWF Area, transit through the OWF Area and the method of co-use of the OWF Area for fishing and transit of fishing vessels to fishing grounds located north of the OWF Area and an extension of the route to these fishing grounds;
- the fishermen showed interest in the methods of surveys conducted as well as the data obtained and the results of surveys and inventories related to the environment, mainly in the scope of ichthyofauna and birds, as well as the condition of the ecosystem, in the context fish returning to the OWF Area after the construction stage and the disappearance of the bay mussel in the OWF Area;

- the potential benefits for the municipalities of Łeba and Władysławowo were indicated, which include the development of the port towards providing services for the OWF and the use of the potential of pleasure craft related to the OWF Area;
- the issue of using local resources of entrepreneurs in the municipalities of Łeba and Władysławowo for the construction and operation process was raised.

The comments and requests of the stakeholders made during the information meetings were recorded on electronic carriers and in writing. At the same time, they create preconditions for a broad public participation in the environmental impact assessment procedure.

15 Indication of difficulties resulting from technical shortcomings or gaps in the state of the art encountered during the preparation of the report

Phytobenthos

Macroalgae coverage of structures located in the PMA has not been investigated so far. Therefore, the analysis of impacts on phytobenthos resulting from the project in question is of predictive nature based on foreign experience gained during the implementation of such projects. It will be possible to verify the effects, force and pace of the impacts on phytobenthos only after analysing the post-implementation monitoring results.

Macrozoobenthos

During the exploitation of the Baltic Power OWF, impacts related to the installation of cables between wind power stations, i.e. emission of heat affecting the water and seabed sediment temperature and emission of electromagnetic field and radiation may potentially occur. At the current stage of the preparation of the preliminary design documentation for the project concerning the technical concept, no detailed data on the size of these parameters for the cables inside the OWF are available. Moreover, in current literature, the issue of potential impact of these cable parameters on the benthic fauna is poorly documented and ambiguous [274, 471]. In the case of heat emission, this factor is unlikely to affect the survival of macrozoobenthos as, in principle, it naturally adapts to considerable seasonal changes of temperature [35]. On the other hand, the effects of electromagnetic field on individual species of benthic fauna, including bivalves, crustaceans or polychaetes, are examined only on the basis of laboratory tests [46, 336, 313, 386], and their results vary depending on the input data and the organisms examined. It is known that electromagnetic field may have an impact on benthic species at the level of biochemical and physiological changes [313], but it is still difficult to determine whether the size of the electric field emitted by AC or DC cables will cause any undesirable changes in the structure and functioning of macrozoobenthos in the OWF Area.

Ichthyofauna

Literature on the subject of impacts related to the construction and exploitation of the OWF is relatively rich, but it refers to areas other than the Southern Baltic. Therefore, when preparing the report, it was necessary to assume that the nature of the impacts in the project area would be similar to the one found in other cases. Data collected in the future as part of monitoring surveys carried out during the construction and exploitation of projects located in the Polish Maritime Areas should fill this gap in knowledge.

No data on potential impacts related to the decommissioning of the project was found. So far, there has been no documented ichthyofauna monitoring during wind farm structures dismantling, therefore, we do not possess knowledge about its course and environmental disturbances caused by such works. It is also difficult to predict what technologies will be available in several dozen years at the time of the project decommissioning. During the impact assessment, it was assumed that the impact would be similar to the one occurring at the time of construction.

In the Baltic Power OWF Area, no ichthyoplankton surveys have been conducted so far. The only source of information to which the results obtained can be referred is the data collected during the one-year-long monitoring of ichthyofauna in the areas adjacent to the planned wind farms. The small amount of data for shallower areas of the Southern Baltic results from the fact that this area lies beyond the network of survey stations where NMFRI usually performs plankton surveys. It is arranged so as to cover the spawning grounds of most fish species caught industrially, excluding shallower water regions. In the case of non-commercial species with early development stages present in both deep water and coastal areas, the available information is scarce and often distant in time and does not relate strictly to the area surveyed.

There is little information on the spatial distribution of ichthyoplankton in the Baltic coastal zone up to a depth of 40 m. However, due to the random performance of these surveys, often only once, at stations in different areas, the data obtained are limited. Some of them refer to single stations along the Polish coast, while some are concentrated in the Gdańsk Bay or in the area of the Pomeranian Bay. Moreover, there is no data on seasonal and multi-annual variability.

Despite the above-presented problems, the survey methodology applied proved to be adequate for the environmental conditions of the Baltic Power OWF Area (among others, the seabed character, hydrometeorological conditions and fishing exploitation). In addition, the use of standard methods for the analyses of catches and biological analyses ensures comparability of the data collected and analysed.

Marine mammals

A major limitation in the collection of data on marine mammals is the high cost, which causes gaps in knowledge about their seasonal distribution in the Baltic Sea area over longer periods of time covering several seasons.

As a result of the monitoring conducted, it was found that the Baltic Power OWF Area is characterised by low acoustic activity of harbour porpoises. In this respect, the results are consistent with the results of the SAMBAH project, but it should be borne in mind that the confidence limits of SAMBAH are very high. The estimates of the abundance of marine mammals are characterised by high statistical variability [418]. Depending on the confidence limit (lower or upper) used in the SAMBAH project, the PTS for the planned project using NRS may occur in 0 to 2 porpoises. Therefore, the impact assessment is difficult. Moreover, the surveys carried out for the purposes of the OWF will not provide precise information on the abundance of marine mammals in the area surveyed due to their small spatial scope and the resulting differences in the abundance and low density of marine mammals in the Southern Baltic.

Noise exposure criteria are also a source of uncertainty. The criteria published by NMFS 2016 and subsequently updated by NMFS 2018 [297] are a step forward as they include frequency-dependent audibility of marine mammals in a more comprehensive manner than it was previously possible. However, the thresholds and weighting functions come from few surveys and are also based on noise sources with slightly different spectral and time properties than those examined in the Baltic Power OWF project, to which animals may respond differently. However, these are the most recent criteria as of today, which is why they have been used in this assessment. The knowledge about the impact of noise on marine mammals is constantly being expanded. Therefore, the calculated impact ranges should be treated with caution.

Additionally, the C-POD devices widely used in porpoise monitoring, which reflect the presence of these marine mammals well [364, 92], have a limited detection range (like other hydrophones), which may condition the detection of porpoises swimming through the area surveyed [148, 416]. This is particularly important in areas with a low density of these animals.

Migratory birds

So far, there is no technology allowing the identification of all migratory species (moving at different heights) at night. The only data collected for night migrants in the central part of the Baltic Sea concerned the areas of the Bałtyk II and Bałtyk III OWFs, and the Baltica 2 and Baltica 3 OWFs [7, 16, 382, 383]. Despite the lack of reports in this respect, the data collected for the Baltic Power OWF are sufficient to formulate conclusions for the needs of the environmental impact assessment for the Baltic Power OWF regarding birds migrating at night.

In the case of Polish coastal waters, apart from environmental surveys for the purposes of the Bałtyk II and Bałtyk III OWFs as well as the Baltica 2 and Baltica 3 OWFs, the surveys carried out in the Baltic Power OWF Area are the only complete study concerning birds migrating in the location surveyed regarding spring and autumn migrations. Results obtained for the area of the Dębki-Białogóra OWF are available; however, these surveys were limited only to visual observations and were not carried out for both migration seasons (autumn observations began in October), and the surveys focused only on waterfowl [64].The monitoring carried out for the purposes of the project related to the construction of the Baltic Power OWF covers, on the other hand, all types of surveys considered the best practice for the purpose of preparing an environmental impact assessment.

European herring gulls, lesser black-backed gulls and great black-backed gulls were often present in the Baltic Power OWF Area and in its vicinity. These species feed mainly in the vicinity of fishing boats and their distribution is reflected in the results of seabird surveys. Although the vast majority of migrations in this area may be related to the presence of fishing boats, migration of these species over long distances cannot be excluded. Due to the fact that it is hardly possible to distinguish during the surveys of migratory birds which large seagull species are feeding and which are migrating, thus, it is practically impossible to obtain information about the size of the seagull migration stream during long-distance migration. Consequently, the risk of collision of large seagulls may have been underestimated.

Seabirds

Modern knowledge about the presence of seabirds in the Baltic Sea is mainly based on surveys carried out in the winter [110, 379]. In the Polish Baltic Sea zone, the surveys in other phenological periods were carried out as part of pre-investment monitoring (the planned Dębki-Białogóra OWF, Bałtyk Północny OWF, Bałtyk II and Bałtyk III OWFs, and the Baltica OWF) or surveys carried out as part of the development of protection plans for Natura 2000 marine sites (Zatoka Pomorska and Przybrzeżne wody Bałtyku). The lack of data on birds staying at sea in the Polish EEZ outside the aforementioned places constitutes a serious obstacle to full interpretation of the results obtained. The example of detecting large, previously unknown concentrations of the common guillemot in the OWF Area demonstrates that our knowledge of birds staying outside the 12-mile strip of territorial waters is still incomplete.

It is also unknown whether seabirds stay all winter in one sea area or move to different parts of the Baltic Sea. Short-distance movements resulting from changes in the abundance of food supply are very likely [282]. However, there are still no reliable data on the migration of seabirds (including the most numerous species of sea ducks) within the Baltic Sea from one remote wintering ground to another.

At this level of knowledge about seabirds gathering in the Baltic Sea away from the coast, the relations between different Natura 2000 sites cannot be fully assessed.

As far as collision estimation is concerned, there is a serious lack of information about the behavioural response of birds consisting in the avoidance of wind power stations, which basically applies to all species. Due to this knowledge deficit, the risk of collision is often assessed considering the precautionary principle, and therefore, the number of potential collisions may be overestimated on the one hand, but also, on the other hand, underestimated.

It is currently not known whether the bird species considered sensitive to the presence of a wind farm (e.g. Gaviiformes, the long-tailed duck and the velvet scoter) will adapt (and if so, to what extent) to the OWF and will start using its area again.

The survey period was divided into four phenological periods. This division is largely conventional, as various species migrate at slightly different time and, e.g. in August the autumn migration of common scoters can already be observed, whereas long-tailed ducks start their autumn passage at the end of September [281]. As demonstrated by the results obtained in these surveys, the spring migration period of sea ducks ends in April and for these species, May should rather be included in the summer period. Nevertheless, the adopted division into four phenological periods allows to group observations into periods when most species of the waterfowl whose presence may affect the project decisions migrate, winter or stay mainly in the coastal zone.

It should be emphasized that the results of visual observations of flying birds carried out during survey cruises may only constitute supplementary material for the analysis of the data obtained during surveys with the use of radars, aimed at birds flying over the OWF Area. The majority of passerines cross the Baltic Sea at night, thus, in order to examine the directions, altitudes and intensity of these movements, it is necessary to record passages using radars. Daytime observations relate, to a large extent, to specimens that did not fit into a typical behavioural pattern, so their passage over the sea does not have to take place in the same way as at night. Moreover, visual assessment of the passage height is certainly vitiated by a large error resulting, among other things, from the observer's position in relation to the passing bird, ship deck movements due to wave motion and the distance to the bird observed, as well as from the individual ability to assess the distance. In addition, birds, especially the small-sized species, are difficult to notice when they pass at significant heights. Therefore, their abundance may be seriously underestimated. Thus, the methodology applied does not provide a complete picture of bird passages, but only supports the results collected using radars.

In this Report, the European herring gull is treated as a species *sensu lato*, i.e. a taxa covering three currently differentiated but very similar species: the European herring gull (*Larus argentatus – sensu stricto*), the Caspian gull (*Larus cachinnans*) and the yellow-legged gull (*Larus michahellis*). Surveys conducted in the northern Poland indicate that the species that clearly predominates among the three is the European herring gull, and the two other appear there rarely [275, 283].

Bats

The assessment of the significance of the OWF Area surveyed on the basis of the conducted monitoring was based on the reference scale included in the project „Wytyczne dotyczące oceny oddziaływania elektrowni wiatrowych na nietoperze" [literally: "Guidelines for the assessment of the impact of wind power stations on bats"] prepared by Polish specialists and practitioners for the General Directorate for Environmental Protection in 2011 [213]. The scale presenting the boundaries of bat activity was prepared on the basis of data obtained during surveys conducted on onshore wind farms. Currently, there are no surveys which would confirm that the limits presented also characterise the activity of bats in maritime areas.

16 Summary of the information on the project

The planned project consisting in the construction, exploitation and decommissioning of the Baltic Power OWF is located in the Polish Baltic Sea EEZ, north of Łeba, at a distance of over 22 km north of the shoreline.

The planned project covers the Baltic Power OWF within the area specified by the decision no. MFW/6/12 on the permit for the construction and use of artificial islands, structures and devices, as amended, obtained by the Applicant. The total area of the sea area intended for the Baltic Power OWF facilities and installations is 131.08 km^2.

The planned project can be implemented in stages.

Offshore wind power stations, offshore substations, electricity grid and telecommunication network together with infrastructure conditioning the correct operation of the Baltic Power OWF will be installed on the seabed at variable depths – within the range from 34 to 45 m.

A project covered by a separate procedure for issuing the decision on environmental conditions will be the connection used for transmission of electricity generated by the Baltic Power OWF from the offshore substations to Żarnowiec Main Transformer Station (MTS).

The most important parameters of the Baltic Power OWF are presented in the table (Table 16.1).

Table 16.1. The most important parameters of the Baltic Power OWF for the Applicant Proposed Variant [Source: own materials]

Parameter	Applicant Proposed Variant
Installed power [MW] (maximum)	1200
Number of wind power stations [pcs] (maximum)	126
Wind power station power output [MW] (minimum)	9.5
Rotor diameter [m] (maximum)	260
Clearance between the rotor operation area and the water surface [m] (minimum)	20
Wind power station height [m a.s.l.] (maximum)	330
Number of MV/HV offshore substations [pcs] (maximum)	6
Number of collective stations (hubs) with a possible AC/DC converter [pcs] (maximum)	2
Number of service and accommodation platforms [pcs] (maximum)	1
Number of measurement and survey platforms [pcs] (maximum)	1
Diameter of Gravity Based Structure [m] (maximum)	55
Seabed surface occupied by Gravity Based Structure [m^2] (maximum)	2375
Seabed surface occupied by foundations [m^2] (maximum)	299 203
Maximum length of cable routes within the internal wiring of the OWF (maximum) [km]	600

The Baltic Power OWF concept is based on assumptions adopted at initial stages of preliminary design work. Therefore, the technical parameters and their limit values for the Baltic Power OWF and individual types of facilities or equipment were determined in an envelope manner and have the maximum permissible values. Detailed parameters of individual wind power stations and their arrangement within the Baltic Power OWF are unknown. Their selection will depend, among others, on the results of preliminary design work and surveys, e.g., geotechnical surveys. Their results, apart from the sea depth, will be the basis, among others, for the selection of the method of anchoring floating structures or the method of constructing support structures with foundations. The use of large-diameter piles, steel truss structures, tripods and GBS or other structures the impact of which will be included in the envelope concept of the project is subject to consideration.

As part of the planned project, the following will be located within the sea area:

- OWPS, anchored or installed on supporting structures with foundations placed on the seabed or embedded in the seabed;
- cable systems of inner array power and telecommunication networks;
- substations;
- optionally, measurement and survey platforms as well as accommodation and service platforms.

It is assumed that different types of wind power stations with different capacity and on different types of foundations or support structures will be used.

The Baltic Power OWF operation cycle covers the following phases:

- construction and manufacturing works at onshore back-up facilities;
- construction of a wind farm in the offshore area;
- period of simultaneous construction and exploitation of subsequent stages of the Baltic Power OWF connected to the NPS in the case of implementing the project in stages;
- Baltic Power OWF exploitation period;
- gradual decommissioning of the Baltic Power OWF components.

In order to avoid, prevent and reduce negative impacts and taking into account the environmental conditions of the planned project, the Applicant left the area without any wind power station installation on the western side of the Baltic Power OWF, thus enabling access to the Natura 2000 site Przybrzeżne wody Bałtyku (PLB990002) for birds migrating from the north and north-east direction.

The indicated restrictions apply to the location of the wind power station structures, offshore substations, accommodation and service platforms as well as measurement and survey platforms.

During construction works related to foundation piling, the NRS system will be implemented. Its use will significantly reduce underwater noise and its impact on marine mammals, fish and birds. In order to monitor the effectiveness of this solution, hydrophones recording the noise level will be installed in the area of the planned project. It has been assumed that the underwater noise level at the boundary of the Natura 2000 site – Ostoja Słowińska (PLH220032) may not exceed the following values: for fish – SEL_{cum} 186 dB re 1 μPa^2s, for porpoises – SEL_{cum} 140 dB re 1 μPa^2s weighted with HF function [297] and for seals – SEL_{cum} 170 dB re 1 μPa^2s weighted with PW function [297].

The table (Table 16.2) presents assessment results of the impact that the planned project will have on elements of the environment in individual phases of its implementation. When conducting the environmental impact assessment, the applied restrictions in the OWF Development Area were taken into account, both in the Applicant Proposed Variant (APV) and in the Reasonable Alternative Variant (RAV).

Table 16.2. Assessment results of the planned project impact in the Applicant Proposed Variant (APV) on the elements of the environment in individual phases of its implementation [Source: own study]

Receiver	**Significance of the Baltic Power OWF impact**			
	Construction phase	**Exploitation phase**	**Overlapping of construction and exploitation phases**	**Decommissioning phase**
Seabed	Negligible	Negligible	Negligible	Negligible
Wave motion and sea currents	None	Negligible	Negligible	No chapter
Sea water	Low importance	Moderate	Moderate	Moderate
Seabed sediments	Low importance	Moderate	Moderate	Moderate
Climate	Negligible	Negligible	Negligible	Negligible
Systems using EMF	None	Negligible	Negligible	Negligible
Phytobenthos	None	Negligible	Negligible	Negligible
Macrozoobenthos	Low importance	Moderate	Moderate	Moderate
Ichthyofauna	Moderate	Negligible	Moderate	Low importance
Marine mammals	Moderate	Moderate	Moderate	Moderate
Migratory birds	Low importance	Moderate	Moderate	Low importance
Seabirds	Significant	Significant	Significant	Significant
Bats	Negligible	Low importance	Low importance	Negligible
Wildlife corridors	Negligible	Negligible	Negligible	Negligible
Biodiversity	Low importance	Significant	Significant	Low importance
Cultural values, monuments and archaeological sites and objects;	None	None	None	None
Use and management of the sea area and material goods;	Low importance	Low importance	Low importance	Negligible
Landscape	Negligible	Negligible	Negligible	Negligible
Population	Moderate	Negligible	Moderate	Negligible

Taking into account the nature and scale of the planned project, its location and restrictions within the Development Area taken into account by the Applicant as well as the use of the NRS system in order to avoid, prevent and reduce negative impacts of the Baltic Power OWF, the following is planned:

- during the construction phase:
  - commencement of piling using the so-called soft-start procedure to allow fish, birds and marine mammals to leave and move away from the work site;
  - piling carried out in the period from August to March under the supervision of ornithologists. If the ornithological supervisors do not observe the presence of the common guillemots, razorbills, long-tailed ducks and velvet scoters in the area with a radius of 2 km from the piling site, the work may begin, preceded each time by the soft-start [259, 359, 248];

  - construction of subsequent power stations beginning from one location, so that the sea area designated for the project is filled with structures gradually, extending the OWF Area by the adjacent power stations;
  - simultaneous piling in a maximum of two locations (in order to reduce noise), regardless whether the two sources are located within the Baltic Power OWF Area or one of them is located in the area of another, neighbouring OWF;
  - intensifying the progress of construction works in the period from March to September, when the number of birds in this sea area is the lowest;
  - at night, limiting sources of strong light directed upwards; this mainly concerns the periods of bird migration. The Applicant declares that they will limit the light emission to the necessary level, resulting from the applicable regulations and work safety standards;
- during the exploitation phase:
  - painting the blade tips bright colours, which should increase the likelihood of the operating wind power station being noticed by the flying birds. The Applicant declares that the painting of the blade tips will be carried out in accordance with the industry standards and will be agreed with the appropriate authorities;
  - illumination of the power stations during night-time conditions through the installation of small, weak and pulsating light sources. Constant, bright lights and pulsating white lights increase the risk of collision. It is also proposed to change the lighting during the limited visibility conditions from continuous to pulsating lighting with a long interval. The Applicant declares that they will limit the light emission to the necessary level, resulting from the applicable regulations and work safety standards;
  - equipping the OWF with a system allowing for a short-term shut-down of selected wind turbines during bird migration periods in the case when the results of operational monitoring indicate that an intensive migration of cranes at the collision height takes place over the OWF Area;
  - abandonment of the use of lattice structures of wind power station towers (not applicable to foundations or supporting structures), due to the greater probability of collisions between birds and the power stations of such structure (less visible to birds from a longer distance).
- during the decommissioning phase:
  - the removal of subsequent power stations beginning from one location, so that the sea area occupied by the OWF is cleared from the structures gradually;
  - maximising the pace of dismantling works in the months of March−September, when the number of birds in this sea area is the lowest.

This EIA Report describes the impact of the project on the environment in a comprehensive and exhaustive manner, indicating that it does not cause significant negative impacts on the environment within the scope described in the Applicant Proposed Variant (APV) and in the Reasonable Alternative Variant (RAV) neither separately nor in conjunction with other projects for which the decisions on environmental conditions have been issued, regardless of the technology used such ase.g., the type of foundation or the size of wind power stations. This also applies to the impact on Natura 2000 Ecological Network sites.

Due to the envelope nature of this report, each of the possible project implementation methods will have a smaller impact than the one described in the Report. An example can be the selection of foundations: if Gravity Based Structure is selected, the impact related to suspended solids will be the greatest and the impact related to underwater noise will be much lower than in the case of foundations requiring piling, during which the impact related to suspended solids will be the lowest and the impact related to noise will be the greatest.

The project impact on the environment was limited by leaving a development-free space on the eastern and western side of the Baltic Power OWF in order to enable bird passages.

In particular, this Report shows that there are no significant impacts related to the exact location of wind power stations inside the OWF Development Area with respect to all environment components in all phases of the project. Therefore, it can be concluded that there is no need to carry out a repeated environmental impact assessment as part of the procedure for issuing the permit for construction.

Both the Applicant Proposed Variant (APV) and the Reasonable Alternative Variant (RAV) analysed are characterised by negligible to moderate impacts in all phases of the project. The intensity of some impacts in the Reasonable Alternative Variant (RAV) is higher than for the Applicant Proposed Variant (APV). These include, for example, an increased vessel traffic or a larger expected amount of generated waste. A relatively higher intensity of these impacts would result from a larger number of wind power stations to be constructed, and consequently, many impacts may last longer and be repeated more times during individual phases of the project. Therefore, it should be stated that the project in the Applicant Proposed Variant (APV) is the most beneficial option for the environment.

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22 Non-specialist abstract

22.1 Preface

22.1.1 Introduction

This document is an Environmental Impact Assessment Report for the Baltic Power Offshore Wind Farm (hereinafter: Baltic Power OWF). The Applicant planning the implementation of the Baltic Power OWF is Baltic Power Sp. z o.o., which is a company of the ORLEN Capital Group.

The planned project is the Baltic Power OWF with a maximum total capacity of 1200 MW, located in the maritime areas of the Republic of Poland, which involves construction, exploitation and decommissioning of the Baltic Power OWF. It will consist of a maximum of 126 wind power stations, 600 km of cable routes, 6 substations and 2 collection stations with a possible current converter.

On 9 May 2012, Baltic Power Sp. z o.o. received a permit from the Minister of Transport, Construction and the Maritime Economy No. MFW/6/12 for the construction and use of artificial islands, structures and devices in the Polish Maritime Areas for the project entitled „Zespół morskich farm wiatrowych o maksymalnej łącznej mocy 1200 MW oraz infrastruktura techniczna, pomiarowo-badawcza I serwisowa związana z etapem przygotowawczym, realizacyjnym i eksploatacyjnym" [literally: "Offshore Wind Farms Complex with a maximum total capacity of 1200 MW together with technical, measurement and survey and service infrastructure related to the preparation, implementation and exploitation stages"]

The aim of the planned project is the generation of electricity using a renewable energy source – wind.

The area of the planned project is not covered by the provisions of spatial development plans. Work on the draft plan has been completed and it is currently at the stage of departmental agreements.

"Environmental Impact Assessment for the Baltic Power Offshore Wind Farm" was prepared by the Consortium of MEWO S.A. and the Maritime Institute Gdynia Maritime University (formerly: Maritime Institute in Gdańsk) in cooperation with the following subcontractors: MIR-PIB, IFAO, Marea Sp. z o.o., DHI Polska Sp. z o.o.

22.1.2 Project qualification

In accordance with the Regulation of the Council of Ministers of 10 September 2019 on projects likely to have a significant impact on the environment (Journal of Laws of 2019, item 1839), the planned project is qualified as a project likely to always have a significant impact on the environment, in accordance with paragraph 2 section 1 point 5)b installations using wind power to generate electricity located in the maritime areas of the Republic of Poland.

Being classified as a project likely to always have a significant impact on the environment, implies the obligation to obtain a decision on environmental conditions (DEC) after the obligatory proceedings regarding the project environmental impact assessment are conducted.

22.1.3 Reasons for the project implementation

Construction of an offshore wind farm (OWF) is one of the strategic objectives of the PKN Orlen Concern. It is in line with the assumptions of the updated energy policy of Poland, which includes the construction of an OWF with a total capacity of 4.6 GW in the Polish Exclusive Economic Zone (EEZ) by 2030. Such actions will enable the transformation of the Polish power industry towards the use of zero-emission energy sources, which is a response to the current climate challenges that Poland, Europe and the world are facing.

An important reason for the implementation of the project is the possibility to avoid emission of pollution into the atmosphere, which, in the context of the project discussed, will constitute an element of fulfilling international regulations at a global and regional level by Poland.

Electricity from wind farms will be the cheapest source of electric power for the European economy according to the experts' estimates. Costs of energy from this type of source will be cheaper by as much as several dozen percent than from the gas energy industry.

22.1.4 Aim and scope of the report

The Project Environmental Impact Assessment Report was developed for the purposes of assessing the impact of the planned project on the environment with the aim of obtaining a DEC.

The objective of the report is to specify:

- the nature and scale of the project;
- possible variants of the project;
- environmental conditions, resources and values of abiotic, natural, cultural and landscape environments;
- the existing and planned use and development of sea areas;
- other conditions resulting, among other, from specific provisions, e.g. concerning the prevention of construction accidents or disasters;
- the nature, extent and significance of the expected environmental, spatial and social impacts related to the construction and exploitation of the Baltic Power OWF;
- the possibility of avoiding, preventing, limiting and possibly compensating for adverse project impacts or threats identified, including potential emergency situations;
- the need to formulate recommendations to be applied at the project design and preparation, implementation and exploitation as well as decommissioning stages;
- the need to protect people and people's health and living conditions from negative impacts;
- proposals for environmental monitoring conducted in all phases of the project.

The subject-matter of the study is the analysis of the impact of the planned Baltic Power OWF on the environment, the comparison of the planned project variants analysed in terms of environmental protection and the indication of the variant most favourable for the environment.

22.1.5 Basis for the report

The basis for the preparation of this report was:

- Applicant's Documentation:
  - Permit for the construction and use of artificial islands, structures and devices in Polish Maritime Areas for the project entitled „Zespół morskich farm wiatrowych o maksymalnej łącznej mocy 1200 MW oraz infrastruktura techniczna, pomiarowo-badawcza i serwisowa związana z etapem przygotowawczym, realizacyjnym i eksploatacyjnym" [literally: "Offshore Wind Farms Complex with a maximum total capacity of 1200 MW together with the technical, measurement and survey as well as service infrastructure related to the preparation, implementation and exploitation stages"] (decision No. MFW/6/12 of 9 May 2012, document no.: GT7/62/1165483/decyzja/2012),
  - „Plan przeciwdziałania zagrożeniom i zanieczyszczeniom olejowym" [Action Plan for Counteracting Threats and Contamination from Oil Spills],
  - „Ocena ryzyka nawigacyjnego" [Navigational Risk Assessment],

  - „Ekspertyza w zakresie wpływu na bezpieczeństwo badań nad rozpoznaniem i eksploatacją zasobów mineralnych dna morskiego" [literally: Expert opinion on the impact on the safety of surveys on identification and exploitation of mineral resources of the seabed],
  - Documentation containing the results of environmental surveys and inventory carried out in the period from October 2018 to March 2020 for the purpose of this EIA Report (Appendix 1 to the EIA Report);
- strategic documentation, programming and planning documents at international, national, regional and local levels;
- applicable legal regulations.

Moreover, when preparing this EIA Report, sources of information specified in section 17 were used, in particular, reports on environmental impact assessment or other documentation for projects completed, implemented or planned, located closest to the planned project.

22.1.6 Findings of the strategic and planning documents

The main premises concerning the implementation of the project include increasing the share of renewable energy and reducing greenhouse gas emissions to the atmosphere. The premises result from the strategic and planning documents.

The planned project is in line with the expectations of many policies and strategies, in particular regarding environmental protection (reduction of pollution emissions), sustainable development (the use of renewable energy sources) and energy security (independence from external energy sources) and is in line with the environmental objectives of the binding strategic and planning documents analysed.

22.1.7 Information on the links between the Baltic Power OWF and other projects

In the Baltic Power OWF Area, the launch of other investors' OWFs is planned. Currently, none of these projects have been implemented. The projects are at various stages of development. Four of them have obtained a decision on environmental conditions (Bałtyk II, Bałtyk III, Baltica 2 and Baltica 3 – as the Baltica OWF). In the case of the B-Wind and C-Wind OWFs, environmental surveys are in progress to prepare the Environmental Impact Assessment Report, while for the Baltic II OWF, the EIA Report was submitted to the Regional Directorate for Environmental Protection (RDEP) in Gdańsk.

22.1.8 Methodology for the planned project impact assessment

When preparing this EIA Report, the results of environmental surveys and inventory surveys carried out in 2018–2020 for the Baltic Power OWF were used. The study also takes into account the results of the information meetings, which were used to clarify the issues of public interest and to develop the part of the report dedicated to the analysis of possible social conflicts.

The work was carried out in accordance with the method of preparation of the environmental impact assessment report. When preparing the EIA Report, first of all, the guidelines, manuals and other materials concerning the preparation of the EIA Report, as well as the experience of the team of authors and generally applicable good practices were used.

Four phases of the planned project were considered in the EIA Report: construction, exploitation, simultaneous construction and exploitation, as well as decommissioning.

The purpose of the EIA Report is to determine potential impacts of the planned project on the environment. The assessment is a study and analytical work performed by a team of specialists. When preparing the EIA Report, analyses of descriptive and cartographic materials were carried out, the impact assessment methodology was applied, as well as the interpretation of the results of the surveys and inventories conducted.

In the EIA Report, the planned project has been analysed in terms of the techniques and technologies used as well as the operating conditions. Among others, the information contained in the documentation of the planned project was used and the potential impact of similar activities that may accumulate was analysed.

On the basis of the data available, environmental surveys and environmental inventories, significant environmental, spatial and social conditions were determined. On this basis, potential impacts and risks related to the planned project were identified. The scope and reach of the expected environmental impact were also determined. Comparisons were made with analogous cases in terms of environmental conditions and the size and nature of impacts.

The approach used to assess the scale and significance of impacts results from the authors' experience gained during the environmental impact assessments of projects planned to be implemented in offshore areas, including OWFs.

The approach adopted allowed identifying comprehensive actions aimed at avoiding, preventing and limiting negative impacts related to the planned project.

Specific impacts were assigned characteristics in four categories: nature, type, range and time range of impacts.

At the same time, the resistance of receptors to individual impacts in the cases of possible interaction between the impact and receptor was determined. Taking into account the characteristics of impacts assigned and the determined receptor resistance to them, the scale (size) of impacts, specific for individual relations between the impact and the receptor, was established. The size (scale) of the impact is described on a five-step scale: negligible, low, moderate, high and very high.

Taking into account the prevalence of a given receptor occurrence, its significance and role in the environment, and, in particular, its conservation status, individual receptors, treated as an environmental resource, were assigned a value (significance), also determined on a five-step scale: negligible, low, moderate, high and very high.

At the next stage of the assessment, taking into account the impact size (scale) assigned and the receptor sensitivity, the significance of the impact was determined also on a five-step scale: negligible impact, low impact, moderate impact, significant impact and substantial impact.

In accordance with the methodology of the environmental impact assessment described above, a significant impact may occur if a "very large" scale of impact is determined and at the same time at least a "high" sensitivity of the receptor and a "high" scale of impact with a "very high" sensitivity of the receptor is stated.

22.2 Description of the planned project

22.2.1 General characteristics of the planned project

22.2.1.1 Subject and scope of the project

The project in question is the construction and operation of the Baltic Power OWF with a total installed capacity not exceeding 1200 MW, together with the technical, measurement and survey as well as service infrastructure related to the preparatory, implementation and exploitation phases, located in the Polish EEZ.

The scope of the project covers its implementation consisting of three main phases: construction, exploitation and decommissioning. The entire project will consist of the following elements:

- wind power stations consisting of nacelles with rotors, towers and foundations or support structures anchored in the seabed or set on foundations on the seabed;
- offshore substations;
- internal power lines and telecommunications systems;
- a measurement and survey station as well as accommodation and service station (optionally).

The EIA Report is based on the concept of an envelope description of the project. This is due to a considerable project extension in time. During that time, the technologies used in OWFs may undergo significant change, the direction of which is to reduce the environmental impact by increasing the power generation efficiency of a single wind power station and reducing their total number necessary to obtain the assumed OWF capacity.

The main assumption behind the envelope concept applied was to determine which parameters of the Baltic Power OWF are significant for the scale of its impact, and consequently to determine the conditions for the project implementation in the decision on environmental conditions (DEC) as well as to ensure that its implementation will not cause significant environmental impact, regardless of the technology ultimately selected from among the ones considered in this Report.

During the work on the OWF structure foundations, noise will be emitted to water. Its greatest intensity will be related to driving large-diameter monopiles with the use of a pile driver. The underwater noise generated at such a level may cause a significant negative impact on marine organisms (fish and mammals) subject to protection in the Natura 2000 site Ostoja Słowińska (PLH220023). Therefore, the Applicant will apply relevant measures and technical solutions to reduce it.

Several concepts of Noise Reduction System (NRS) can be applied. At present, it has not been determined which NRS concept will be implemented for the Baltic Power OWF implementation. The fundamental condition determining the selection of specific NRS solutions will be not to exceed the Temporary Threshold Shift values for fish and marine mammals at the boundary of the Natura 2000 site Ostoja Słowińska (PLH220023).

22.2.1.2 Location and the sea area taken by the project

Baltic Power OWF Area is located in the Polish EEZ, north of Łeba and Choczewo municipalities, 22.5 km from the shoreline. The Baltic Power OWF project will be executed entirely within the area indicated in the PSzW permit.

From the north and south, the Baltic Power Development Area will reach the boundary of the area with the PSzW permit. The western boundary of the Baltic Power Development Area, in its northern section, will reach the boundary with the PSzW, and then it will run within a 500 m distance from the boundary of PSzW until the turn point. Further, the western boundary of the Baltic Power Development Area will extend from the boundary of the area with the PSzW, down to the south-western point of the area with the PSzW. The eastern boundary of the Baltic Power Development Area, in its north-eastern section, will run along the boundary of the area with PSzW, and then within a distance of 500 m from the boundary with PSzW.

The surface are of the Baltic Power OWF Area is 131.08 km^2, while the surface of the Baltic Power OWF DA is 113.72 km^2.

22.2.1.3 Stages of the project implementation

In order to:

- mitigate the risk of failure to meet the time frames indicated in the Act of 21 March 1991 on maritime areas of the Republic of Poland and maritime administration to maintain the PSzW for Baltic Power Sp. z o.o. in force;
- optimise economically the entire project;
- enable the comprehensive contracting of the necessary services and supplies;
- consider the limitations in the access to essential services and supplies (specialist vessels, port infrastructure and other components in the supply chain) related to the possible implementation of similar investment plans in the offshore wind energy sector by other entities,

the Applicant allows for the implementation of the project in a continuous process as well as in stages.

22.2.2 Description of technological solutions

The section below provides information on the most frequently used or planned technological solutions for the process of electricity generation in OWE. The most common systems currently used, based on alternating current generation and transmission, can be replaced by the Applicant with the systems based on direct current generation and transmission, or any combination of the two. At the stage of the EIA Report submission, the Applicant does not exclude the use of either of these technologies.

22.2.2.1 Description of the production process

Wind power stations are devices designed for converting kinetic energy of wind into electricity by means of a wind-driven rotor driving a power generator. The mechanical energy of the rotor is converted into low-voltage AC electricity, which is usually converted to medium voltage and then to high voltage for further transmission.

Due to the location conditions, wind farms installed in maritime areas are built as complexes of individual wind power stations together with the associated infrastructure designed to deliver the electricity produced to an onshore substation or to monitor the OWF capabilities.

Wind power stations do not require the supply of other fuels and raw materials to produce electricity. Properly operated, they do not generate environmental pollution. The demand for electricity, in small amounts, occurs only in the case of windless weather. The demand for raw materials and energy, similarly to other energy installations, is related to the process of construction and installation of structural elements of individual wind farm components, operation of service vessels and decommissioning.

22.2.2.2 Description of the technological solutions for individual elements of the project

The offshore wind farm consists of four main components, connected functionally and structurally: i) wind power station, ii) foundations or support structures, iii) connection infrastructure, iv) non-productive infrastructure.

22.2.2.2.1 Wind power station

The wind power station is an essential component of the wind farm. It comprises three main structural elements, each with a specific function: a tower, a nacelle and a rotor.

The **tower** is a structural element connecting the nacelle with the support structure or the foundation. Its size and weight are adapted to the specific project and depend on the parameters of the other elements of the wind power station, type of support structure or foundation and the environmental conditions at the site. In addition to its basic support function, the tower provides the foundation for laying control cables of the wind power station, power cables as well as other installations and devices necessary for the proper operation of the system. The tower can feature internal and external platforms ensuring service teams' access to both the nacelle and the elements of the tower itself.

The **nacelle** constitutes a key component of a wind power station. It consists of the drive system devices and a housing protecting it against weather conditions. The drive system ensures the conversion of rotational energy from the rotor to three-phase alternating current. The generator produces electricity as a result of electrical induction, by placing moving parts in the magnetic field. In the case of gearless turbines, the rotation of the rotor is transferred directly to the generator.

The **rotor** consists of blades and a hub. Under the influence of wind, the rotor rotates, capturing and transferring its energy to other parts of the nacelle. The blades are made of composite materials. They are equipped with electric discharge protection systems. The power of a wind power station depends largely on the size of the rotor.

22.2.2.2.2 Supporting structures with foundations

The tower of the wind power station that is not a floating structure is installed on a support structure or foundation, which is permanently attached to the seabed. The support structure or foundation is primarily designed to ensure:

- adequate rigidity and strength of the wind power station;
- support for wiring systems;
- connection of the wind power station to the seabed;
- effective installation of the wind power station.

Selection of the appropriate type of support structure or foundation depends on the size and weight of the wind power station on the one hand, and on the other hand, on the environmental conditions prevailing in the OWF Area: the depth of the sea and geological conditions of the seabed. Other important factors determining the type of support structure or foundation include environmental conditions (wave motion, currents, ice cover, biotic characteristics) and the economic aspect.

Depending on how they impact the seabed, support structures or foundations can be divided into two categories:

- permanently and directly fixed to the seabed;
- floating, moored to the seabed through anchoring systems.

Support structures or foundations that can be permanently attached to the seabed in the Baltic Power OWF Area include: large-diameter monopile, jacket structure, tripod structure and Gravity Based Structure (GBS) or others, the impacts of which will remain within the envelope concept of the project. Floating support structures are also possible.

Floating support structures constitute a separate type of support structures, compared to the ones mentioned above. Depending on the method of stabilisation, four types of floating support structures can be distinguished: barge, semi-submersible, spar and tension-leg platform.

22.2.2.2.3 Connection infrastructure

The OWF connection infrastructure comprises: power lines (internal cabling) and power substations.

OWF **inner array cables** connect wind power stations with substations located within the wind farm area. **Substations**, which include substations and converter stations, are designed to transform and transfer the energy generated by wind power stations to land. Among these, the following types can be distinguished:

- collection substations;
- converter stations AC/DC and DC/AC.

Substations are designed to increase the voltage of current from wind power stations to the level of transmission. **Converter stations** are designed to convert alternating current (AC) to direct current (DC).

22.2.2.2.4 Non-productive infrastructure

As part of the Baltic Power OWF implementation, it is possible to build (optionally) two platforms not directly related to power generation: measurement and survey platform and accommodation and service platform.

The **measurement and survey platform** will be used for conducting measurements, mainly meteorological and hydrological. Offshore **accommodation and service platforms** are used as a local base for activities related to the OWF construction, operation, maintenance and decommissioning.

22.2.3 Project variants considered

22.2.3.1 Approach to designating project variants

The planned project was described using the same parameters for the two variants analysed in the further part of the EIA Report, i.e.: Applicant Proposed Variant (APV) and Rational Alternative Variant (RAV). Maximum possible values of these parameters were assumed in each case. This assumption allows for an Environmental Impact Assessment to be carried out with a large safety margin, as the maximum individual parameters will always be considered in the assessment, even if they do not actually occur cumulatively.

The project was characterised by the following parameters specified for each variant:

- the maximum total installed capacity of the OWF;
- the maximum total number of wind power stations;
- the maximum diameter of the rotor of a wind power station;
- the minimum clearance between the rotor operation area and the water surface;
- the maximum height of a wind power station structure including the rotor;
- the maximum length of cable routes of the OWF internal wiring.

22.2.3.2 Project variants considered together with the justification of their selection

In accordance with the requirements of the EIA Reports, both variants subject to assessment are rational, i.e. feasible under the existing legal status (including the PSzW decision), technical and technological conditions and with the current state of knowledge about environmental conditions.

22.2.3.2.1 Applicant Proposed Variant (APV)

The Applicant Proposed Variant is the variant assuming the application, to the greatest extent possible, of state-of-the-art technological solutions available on the market. It also assumes that the Baltic Power OWF will achieve the maximum total nominal power specified in the PSzW. This variant provides for the possibility of using wind power stations of various capacities, however, the power of an individual turbine cannot be lower than 9.5 MW. Moreover, different types of foundations or support structures are allowed. The implementation of the Baltic Power OWF project with a total maximum capacity specified in the PSzW (up to 1200 MW), assumes the installation of up to 126 wind power stations.

The Applicant assumes the installation of wind turbines of at least 9.5 MW under this variant, any other feasible solution (with higher turbine capacity) will result in the following: the decrease in the number of wind power stations, the decrease in the total rotor operation area and the reduction of the risk related to the number of offshore operations.

In fact, according to further analyses of the environmental impact, the APV is a more environmentally beneficial option, compared with the RAV.

22.2.3.2.2 Rational Alternative Variant (RAV)

The Rational Alternative Variant has been selected as a variant based on existing technologies that are currently applied and available on the market. This variant assumes a wind power station with a capacity of 5 MW. The assumed wind power station capacity, with a maximum total nominal capacity of the OWF indicated in PSzW, determines the number of wind power stations, which for this variant is 240.

Similarly to the APV, it is assumed, in the RAV, that different types of wind power stations can be used, on different types of foundations or support structures.

22.2.3.2.3 Compilation of the technical parameters of the project variants considered

The table below (Table 22.1) presents the most important parameters of the project for both variants analysed in this EIA Report.

Table 22.1. Compilation of key parameters of the Baltic Power OWF for the Applicant Proposed Variant (APV) and the Rational Alternative Variant (RAV) [Source: own materials]

Parameter	Unit	APV	RAV
Maximum installed capacity	MW	1200	1200
Maximum number of wind power stations	-	126	240
Maximum rotor diameter	m	260	180
Minimum clearance between the rotor operation area and the water surface	m	20	20
Maximum structure height including the rotor	m	330	250
Maximum number of additional structures	-	12	12
Maximum length of cable routes in internal wiring	km	600	600

22.2.4 Description of particular phases of the project

22.2.4.1 General information relating to all phases of the project

Due to the location of the planned project, implemented within the maritime area, all activities related, in all project phases, will be conducted in in a manner typical of maritime operations, taking into account their unique conditions and specificity. Deliveries to and from the OWF Area will be carried out with the use of various types of vessels.

Activities related to the transport of large-size structural elements of the OWF must be carried out from ports that meet specific requirements:

- sufficient length and bearing capacity of the quay, allowing the assembly, storage and loading of the OWF structural elements;
- appropriate depth of port basins, allowing for the operation of large construction vessels.

At the current development stage of the Baltic Power OWF project, the following ports of installation are considered: Gdynia, Gdańsk, Sassnitz-Mukran, Szczecin, Świnoujście, Rønne, Rostock, Aalborg, Karlskrona and Klaipeda.

During the exploitation phase of the Baltic Power OWF it will be possible to use smaller ports, located at a shorter distance from the area of the planned project than the ports indicated above, i.e. the ports in Władysławowo, Ustka, Łeba, Hel, Darłówek as well as Kołobrzeg or Dziwnów.

The information about activities conducted during the OWF construction phase, the establishment of safety zones around OWF structures, as well as a total or partial decommissioning of the OWF will be published in official publications of the Hydrographic Office of the Polish Navy.

In each phase of the Baltic Power OWF implementation, mandatory legal requirements and good practices will be applied regarding waste and sewage treatment.

All vessels involved in the project will meet the requirements and will comply with the regulations resulting from the International Convention for the Prevention of Pollution from Ships, including, in particular, the procedures contained in "Shipboard Oil Pollution Emergency Plans".

The same will be done in the case of other waste, including other hazardous waste – it will be sorted, collected in specially marked and secured containers, transported ashore and transferred to specialised companies for utilisation.

22.2.4.2 Construction phase

The OWF construction phase is the phase of the project requiring the mobilisation and involvement of the largest number of vessels, equipment and human resources, both in the APV and the RAV variant. It is necessary to develop a complex process of simultaneous supply chain of goods and specialist services in various areas: manufacturing, transport, construction, assembly and installation.

Depending on the strategy adopted for the project implementation, the actions may be performed sequentially or simultaneously.

The construction phase will last 2 to 8 years. Before the commencement of the OWF construction phase, it will be necessary to set up an onshore area, where the assembly of wind power station components will be performed and where OWF construction elements will be stored. The area will be located in a port or shipyard infrastructure existing for the duration of the project, with a direct or very good access to a quay dedicated to the operations of loading and unloading of vessels involved in the construction process and subsequent maintenance of the OWF. Individual elements of the OWF will be transported by ships to the area of their foundation or installation.

Depending on the depth and geological conditions in the area of the Baltic Power OWF and on the type of foundations or support structures used, relevant activities will be performed to prepare the seabed before setting the foundations for OWF structural elements.

It is assumed that the sediments displaced will be fully managed within the Baltic Power OWF Area. The sediment will be handled only in the closest vicinity of the work.

Maritime transportation will be of main significance and the impact of land transportation should be minimal. Land transportation will be carried out using the existing transportation solutions.

22.2.4.3 Construction and exploitation phase

The OWF construction concept assumes the possibility of simultaneous OWF construction and exploitation. In terms of impact assessment, this phenomenon will be the sum of the simultaneous impact of the OWF construction in one place and of exploitation elsewhere. Due to the different location and different technical requirements, conflicts and collisions should not be expected, provided that the exploitation and further development of the OWF will be covered by the coordinated ship traffic plan in the OWF Area.

22.2.4.4 Exploitation phase

Unlike the construction phase, this phase will be characterised by a reduced vessel traffic. Regarding the general vessel traffic, an increased proportion of small and medium-sized vessel traffic related to the OWF exploitation and maintenance will be recorded for this phase.

The number of specialist offshore operations related to the exploitation phase of the Baltic Power OWF will be proportional to the number of facilities installed and constructed in the OWF Area, including also the length of the installed electricity grid. Therefore, the number of operations and their effects (e.g. fuel consumption, emissions related to transport) for the APV will be smaller than for the RAV.

The OWF exploitation will be a long-term project. Offshore wind power stations will be connected with the offshore substations by power grids and telecommunication networks. Cables buried in the seabed are optimised to emit a residual electric field. Electric current, flowing through a cable, causes it to heat up. As the temperature of the cable increases above the ambient temperature, the transfer of heat from the cable to the surrounding environment commences. According to the OSPAR's guide on the best environmental practices in the laying and use of subsea cables, the burial of the cable at a depth of 1 to 3 m under the seabed is sufficient to prevent the rise of the sediment temperature within 0.2 m below the seabed surface, which is associated with heat emission through the power cables under load, to more than the recommended 2°C.

Generation of waste related to a normal exploitation of the OWF is expected. The main factors causing the generation of waste and wastewater during the Baltic Power OWF exploitation phase is the operation of ships and carrying out of repairs. The amount of solid waste and wastewater will be significantly higher in the case of the RAV than the APV.

22.2.4.5 Decommissioning phase

In technical terms, the decommissioning phase is a reversal of the OWF construction phase. In the reverse order of the construction phase, individual OWF components will be removed and transported to disposal sites.

The number of specialist offshore operations related to the decommissioning phase of the Baltic Power OWF will be proportional to the number of facilities installed and constructed in the OWF Area, including also the length of the electricity grid installed. Therefore, the number of operations and their effects for the APV will be smaller than in the case of RAV.

Waste will be generated during the decommissioning phase. Comparing its amount for the APV and the RAV variants, it can be assumed that the amount of solid waste and wastewater will be significantly higher in the case of the RAV than the APV.

It is expected that decommissioning of the structures in the Baltic Power OWF Area will take place to the level of the seabed. In the case of the decommissioning of the Baltic Power OWF, the generation of waste is mainly related to the physical removal of the worn-out components of the Baltic Power OWF and the operation of ships used during the decommissioning.

22.2.4.6 Information on energy demand and consumption

The most important factor shaping the energy demand and consumption is the choice of the structure types erected in the OWF Area and the organisation of construction works, and later the selection of one of the OWF operation methods. The energy needed and consumed for the construction of the OWF is almost 100% fuel used for transportation, transshipment and installation of wind power stations and other OWF facilities.

The number of offshore operations related to the construction, exploitation and decommissioning phases of the Baltic Power OWF will be proportional to the number of facilities installed and constructed in the OWF Area, also including the length of the power cables installed. Therefore, fuel quantities and transport related emissions will be lower for the APV than for the RAV.

22.2.5 Risk of major accidents or natural and construction disasters

22.2.5.1 Types of breakdowns resulting in environmental contamination

The project discussed in this Report is not a place of storage of substances determining the project classification as a plant with an increased or high risk of a serious industrial accident.

The main threats that may occur during an OWF construction and decommissioning are the spillages of oil derivative substances. To a lesser extent, the marine environment may incidentally be endangered with materials containing hazardous substances, if they were used. During the exploitation phase, the main cause of marine pollution can be oil spills. Both within the open sea waters and near the coast, they can constitute a problem with long-lasting effects on fauna, flora, fishery and beaches affected by the contamination. In order to counteract this threat, OWF installations will be equipped with protective measures against spillage of hazardous substances, as described in the subsection below.

Various leakages of oil derivatives may occur during normal vessel operations. It should be assumed that these will be small spillages.

The areas particularly vulnerable to potential contamination are the protected areas. The number of potential leaks is proportional to the number of vessels used to carry out the project implementation, its exploitation or decommissioning.

During the construction, exploitation and decommissioning phase of the Baltic Power OWF a spillage of oil derivatives may occur in an emergency situation, the consequence of which will be the water and sediment contamination. A leak may occur as a result of a breakdown or collision of vessels, their collision with OWF structures, their sinking or grounding, as well as during seepage and operational leaks from vessels, leakage from oil systems of a wind power stations, leakage from transformers at substations or oil spills related to inspections and repairs of OWF elements. In the worst case scenario, during the construction or decommissioning stage, spills of medium size will occur.

During the construction of a wind farm, the waste generated aboard vessels and in the infrastructure situated on land and on the project site will be related to the process of construction. The possibility of releasing waste or chemicals into the water is proportional to the activity associated with the use of chemicals.

Other types of releases may include: i) release of municipal waste or domestic sewage, ii) contamination of water and seabed sediments with antifouling agents and iii) release of contaminants from anthropogenic objects on the seabed.

22.2.5.2 Environmental threats

The potential events of the **construction phase** that can become the source of negative OWF impacts on the environment include: i) spillage of oil derivatives as a result of vessel or helicopter collision, an accident or a construction disaster, ii) accidental release of municipal waste and domestic waste water,

iii) accidental release of building materials or chemicals and iv) contamination of water and seabed sediments with anti-fouling agents.

As a result of emergency incidents and situations, the abiotic environment, i.e. seawater and seabed sediments, can become directly contaminated. These events can also indirectly affect living organisms. The contamination of water or seabed sediments with municipal waste or domestic sewage is a direct negative impact, temporary or short-term, reversible and of local range. The scale of the impact is negligible.

The collision of ships and helicopters and the resulting release of hazardous substances into the environment is a factor which can cause increased mortality and diseases of marine organisms. The likelihood of such events can be considered as small.

The main threat to the Natura 2000 sites during the construction phase is the release of hazardous substances into the environment as a result of collisions of ships and helicopters. It can be assumed that this factor will not affect the protected areas significantly.

During the OWF **exploitation phase**, environmental threats may also occur; in particular, the contamination of water and seabed sediments with: i) oil-derivative substances, ii) anti-fouling agents, iii) accidentally released municipal waste or domestic sewage and iv) accidentally released chemical agents and waste from the OWF exploitation.

Waste and sewage will be generated by people on ships and during exploitation, as well as during maintenance of towers and transmission infrastructure.

The collision of ships and helicopters and the resulting release of hazardous substances into the environment is a factor which can cause increased mortality and diseases of marine organisms. The likelihood of such events can be considered as small. The implementation of a proper plan of action in case of collisions and spills aims to limit the impact of such events on marine organisms.

The main threat to the Natura 2000 sites during the exploitation phase is the release of hazardous substances into the environment as a result of collisions of ships and helicopters. This factor may cause increased mortality and diseases of marine organisms, including the subject of protection in these areas. The likelihood of such events can be considered as small.

During the **simultaneous construction and exploitation phase** the collision of ships and helicopters and the resulting release of hazardous substances into the environment is a factor which can cause increased mortality and diseases of marine organisms. The likelihood of such events has been considered small in the case of separate implementation of works related to the construction and exploitation phase. However, the simultaneous presence of vessels engaged in construction and service works increases the risk of collisions and the negative impacts associated with them. Therefore, the original significance of the impact (ranging from low to negligible) may increase to moderate; however, this will not necessitate the application of mitigation measures.

During the OWF **decommissioning phase** impacts may occur resulting from the occurrence of emergency situations and other environmental hazards, in particular, the contamination of water and seabed sediments with: i) accidentally released municipal waste and domestic sewage, ii) oil derivatives and iii) anti-fouling agents.

The risk of sewage release from the ship into the water exists at the time of the collection of sewage from a ship by another vessel and in the event of a breakdown. It may cause local increase of nutrient concentration and the deterioration of the water quality. The contaminants should rapidly dissipate, which will stop them from contributing to a permanent environment deterioration in the project area.

The impacts related to environmental threats in the decommissioning phase are identical to the described above impacts for the OWF construction phase.

22.2.5.3 Breakdown prevention

The prevention of breakdowns constitutes the whole range of activities related to the protection of human life and health, the natural environment and property, as well as the reputation of all participants in the processes related to the construction, exploitation and decommissioning of the OWF. These activities include, among others:

- developing plans for safe construction, exploitation and decommissioning of the OWF;
- developing rescue plans and training of crews and personnel;
- developing a plan for counteracting threats and pollution;
- selecting suppliers as well as certified parts and components of the OWF;
- designating protection zones;
- accurate marking of the OWF Area, its facilities and vessels moving within the area;
- planning offshore operations;
- observing standards and guidelines;
- providing navigational supervision;
- continuous monitoring of vessel traffic within the OWF;
- establishment of a coordination centre supervising the implementation of the OWF;
- maintaining regular communication lines between the OWF coordination centre and the coordinator of works at sea and other coordination centres.

22.2.5.4 Design, technology and organisational security expected to be applied by the Applicant

Design, technological and organisational security relies on carrying out navigational risk assessments and developing prevention plans against:

- threats to human life – evacuation plans, search and rescue plans;
- fire hazards;
- threats of environmental pollution – a plan to counteract the threats and contamination by oil;
- threats of construction disasters.

22.2.5.5 Potential causes of breakdowns including extreme situations and the risk of natural and construction disasters

The OWF structures are designed and erected with the idea of withstanding extreme atmospheric conditions. All components, despite being subject to extremely high stresses, are adapted to many years of exploitation. All devices are subject to continuous monitoring. The rotor is stopped automatically if the wind speed exceeds the limit value for a safe wind power station operation. The service plan is intended to ensure flawless operation.

The potential greatest risks occur during the construction phase; however, the risk of disaster is minimal due to the fact that the planning of offshore operations always takes into account weather conditions and the possibility of their change. Every offshore operation has its limitations in terms of visibility, wind speed, sea state or ambient temperatures. The occurrence of negative effects of climate change in the form of too strong wind or too high waves can only result in the extension of the construction cycle and an increased demand for energy.

22.2.5.6 Risk of major breakdowns or natural and construction disasters, taking into account the substances and technologies applied, including the risk related to climate change

The risk of a major accident resulting in the emission of hazardous substances is minimal. The probability of events such as ship collisions belongs to the category of very rare events, such as vessel contact with the OWF structure. Taking into account the effects in the form of 200 m^3 of diesel oil emission, the risk level is within an acceptable range. The emission of 200 m^3 of diesel oil will cause insignificant damage to the environment because it will disperse within 12 hours.

22.2.6 Relations between the parameters of the project and its impacts

The matrix of connections between the project parameters and impacts is presented in the table (Table 22.2).

Table 22.2. A matrix of connections between project parameters and impacts [Source: internal materials]

Parameter	**Type of emission or disturbance**															
	Above-water structures	**Underwater structures**	**Heat**	**Electromagnetic field (EMF)**	**Above-water noise**	**Underwater noise**	**Waste**	**Light effects**	**Seabed disturbances**	**Suspended solids**	**Resuspension of contaminants**	**Redeposition**	**Creation of an “ artificial reef”**	**Water contamination**	**Air pollution**	**Increased traffic and collision risk**
Number of wind power stations	X	X			X		X	X								X
Number of foundations or support structures		X				X	X		X	X	X	X	X	X		
Type of foundations or support structure and the scour protection width						X			X	X	X	X	X	X		
Diameter of the support structure foundation		X				X			X	X	X	X	X			
Pile-driving parameters						X										
Total structure height	X				X			X								X
Rotor diameter	X															
Length and type of cables		X	X	X						X	X	X				X
Depth and method of cable laying/burying			X	X		X					X					
Number and size of substations	X	X		X	X			X								
Organisation of technological processes (number of vessels, duration)					X	X	X	X						X	X	X

22.3 Environmental conditions

22.3.1 Location and seabed topography

The Baltic Power OWF Area (1 NM) is situated east of the Słupsk Bank and covers a seabed section with a depth from 28.1 to 45.4 m. The depth increases to the north.

On the basis of the bathymetric and sonar data analysis, a full identification of the seabed surface relief and characteristics was carried out. On that basis, using the interpretation of seismic and seismo-acoustic data and the data from the analyses of surface and vibrocorer samples, as well as taking into account the general knowledge about the area, a map of seabed surface types was created.

Within the area analysed, three seabed types, different in terms of structure and relief character, were distinguished: the abrasive-accumulative plain, kame terraces and the accumulation platform.

22.3.2 Geological structure, seabed sediments, raw materials and deposits

22.3.2.1 Geological structure, geotechnical conditions

According to the data from literature, Quaternary sediments deposited on the Paleogene and Neogene sediments were identified in the seabed structure of this area. Below the Paleogene and Neogene layer, the Mesozoic (Triassic and Cretaceous) sediments were identified. They occur only in the southern part of the survey area. Below the Mesozoic deposits, in the northern part of the survey area, directly below the Paleogene and the Neogene sediments, the Silurian deposits are present.

22.3.2.2 Seabed sediments and their quality

Almost the entire seabed surface of the area analysed is covered with a discontinuous layer of fine- and medium-grained sands. In places, accumulations of multi-grained sediments, boulder clusters and cohesive sediment outcrops occur on the surface.

Two types of sediments forming the seabed surface were distinguished in the Baltic Power OWF Area (1 NM): fine- and medium-grained sands, and till with a stony-gravel abrasive pavement and a sandy cover.

The nutrient content (total phosphorus) in the area surveyed did not exceed the values typical for the sediments of the Southern Baltic.

The concentrations of persistent organic pollutants and harmful substances such as metals or mineral oils, in the area surveyed were low and did not exceed the values typical for the sandy sediments of the Southern Baltic. The sediments surveyed were also characterised by a low activity of the radioactive isotope of caesium, typical for sandy sediments.

22.3.2.3 Raw materials and deposits

In the seabed structure of the area analysed, no parameters appropriate for the accumulations of fine and medium-grained sand, which could constitute a mineral deposit, were recognised. Sands identified create a layer with a thickness of 0.5 to 2 m, only locally up to several meters. Sands are deposited on a silty-clayey substrate, locally on a till substrate.

22.3.3 Seawater quality

The concentrations of the chemical parameters of water surveyed in the Baltic Power OWF Area (1 NM) did not deviate substantially from the contents typical for the waters of the Southern Baltic.

These waters were characterised by an alkaline pH and a relatively good oxygenation, with seasonal variability characteristic of the Southern Baltic waters. The assessment of the water quality index in the Baltic Power OWF Area (1 NM), on the basis of the oxygen content in the near-seabed layer in summer, indicates a good water status. The content of suspended solids in particular measurement periods was at a level typical for the waters of the Southern Baltic.

The content of nutrients was characterised by a seasonal variability which is characteristic for the Southern Baltic waters. Waters of the area surveyed were characterised by low (trace level) contents of particularly harmful substances.

The waters tested were also characterised by low values of radioactive element activity, typical for the waters of the Southern Baltic. Concentrations of aromatic hydrocarbons slightly higher than the ones cited in literature were observed in the Baltic Power OWF Area (1 NM).

Taking into consideration the distance of the Baltic Power OWF Development Area to the nearest surface water body and the impact range of the project, it should be assumed that the implementation of the Baltic Power OWF shall have no impact on the achievement of the environmental objectives for this surface water body.

22.3.4 Climatic conditions and state of the air

22.3.4.1 Climate and the risk related to climate change

On the basis of the data and analyses available, it is possible to indicate the most important forecasts of changes in particular elements of the atmosphere and water in the Baltic Sea region:

- the increase in air temperature is faster here than the average global increase, this trend will continue;
- the increase in surface water temperature is greater than in its deeper layers, this may result in stronger thermal stratification and the stabilisation of the thermocline throughout the year;
- the predicted salinity changes are not clearly defined and depend, on the one hand, on the changes in the air circulation conditions and the volume of water exchange with the North Sea and, on the other hand, on the volume of river water inflow; a decrease in salinity level is predicted;
- an increase in atmospheric precipitation is forecast for the entire Baltic Sea basin in winter, while in summer only in the northern part; the prevalence of extreme precipitation will increase;
- in terms of forecasting the changes in sea level, the effects of its global increase will not be felt to a significant extent.
- forecasts of wind climate changes are subject to considerable uncertainty, it is assumed that with the increase in the average surface water temperature, the average wind velocity over sea areas will increase;
- changes in wave climate are mainly related to the increase in the frequency and intensity of storms;
- model calculations indicate that there will be an increase in the surface area of low oxygen content areas and anaerobic areas near the seabed.

Due to the increase in the average water temperature and an increased inflow of biogenic pollutants into the sea, a negative phenomenon which will occur will be the progressive eutrophication, especially on the surface of the water.

22.3.4.2 Meteorological conditions

The meteorological conditions of the sea areas encompassing the Baltic Power OWF Area were specified on the basis of the surveys of the near-water layer parameters. The average wind speed for the entire survey period was approx. 7.3 $m \cdot s^{-1}$, and reached almost 20 $m \cdot s^{-1}$ at maximum. Winds from the western and south-western sectors prevailed. Air temperature ranged from approx. -3.1°C to approx. 28.3°C. Atmospheric pressure varied from 975.7 hPa to 1046.4 hPa. Relative humidity was characterised by high variability, oscillating from approx. 40% to 100%.

22.3.4.3 Quality of air

The assessment of air quality in the near-water atmosphere layer was compared with the information obtained as a result of the surveys carried out for the nearest coastal station (Łeba). Due to the lack of significant pollution emission sources over the sea area, parameters of air purity should not be worse than those measured at the shore. The area of the coastal zones in the vicinity of Łeba has air quality class A.

22.3.4.4 Ambient noise

The results of ambient noise monitoring conducted in the Baltic Power OWF Area, show that the levels of underwater noise (and their variability ranges) indicate values characteristic for the Southern Baltic area.

22.3.5 Electromagnetic field (EMF)

In the marine environment, the values of the electric field and the geomagnetic field are similar. In the Baltic Power OWF Area, there are no artificial sources of electromagnetic field. The existing DC transmission system between Poland and Sweden (SwePol Link) is located at a distance of several dozen kilometres from the planned OWF location.

Changes in the natural electric fields do not have a direct impact on the living organisms. Natural magnetic fields show differences depending on the geographical location. They have a significant impact on some living organisms.

Electromagnetic fields created as a result of electric current flow can change the natural migratory behaviour of marine mammals and fish, they can also be the source of thermal energy introduced into the marine environment.

22.3.6 Description of the natural environment components and protected areas

The surveys conducted in the Baltic Power OWF Area (1 NM) indicated the lack of **underwater vegetation**, either rooted in the seabed sediment or attached to boulders and stones on the seabed.

Macrozoobenthos is a group of invertebrate organisms living on the surface layer of seabed sediments (epifauna), as well as the hard substratum (boulders, stones) or living inside the sediments (infauna). For the purposes of this report, separate surveys of macrozoobenthos on the soft bottom (sandy sediments) and on the hard bottom (boulders, stones) were conducted. On the soft bottom in the OWF Area (1 NM), a presence of 25 taxa was confirmed, among which the group of absolutely constant species included the polychaetes *Marenzelleria* sp. and *Pygospio elegans*. On the hard bottom, 16 taxa belonging to 6 classes and a single subclass were recorded. Bay mussel (*Mytilus* sp.) dominated in the abundance and biomass structures.

In the Baltic Power OWF Area (1 NM), **fish** belonging to 22 taxa were caught. Permanent fish communities included cod, flounder, plaice, turbot, herring, sprat and sparsely occurring shorthorn sculpins, lumpfish, great sand eels and viviparous eelpout. The presence of larvae of such species as gobies, fourbeard rockling, rock gunnel, longspined bullhead or common seasnail is not an evidence of the permanent inhabitation of the area by the adult fish. This Area is poor in terms of species diversity, with a distinct prevalence of cod and flounder in demersal catches and herring and sprat in pelagic catches. The survey area was not recognised to be a significant breeding area. Only in summer, it was found to be a non-significant breeding area for sprat.

The results of the harbour porpoise acoustic monitoring, aerial visual observations and additional observations of **marine mammals** from aboard survey vessels conducted as part of the seabird surveys, confirm a low occurrence of harbour porpoises and seals in the Baltic Power OWF Area (2 NM) surveyed.

During the **migratory bird** surveys, a total of 96 species were observed over the OWF Area (2 NM), for 67 species flight paths were created and 28 species were identified on the basis of acoustic recordings. During the entire survey period, the most frequently observed birds were geese (in most cases, unidentified as to the species), common scoters and long-tailed ducks. Less numerous, but still often observed species were: the common wood pigeon, common guillemot, razorbill, Euroasian wigeon, greater scaup and the common gull.

Most flight paths were recorded for common scoters, long-tailed ducks, common wood pigeons, Eurasian skylarks, Eurasian wigeons and velvet scoters. The analysis of the echo recorded by the vertical radar indicates the most intense migration in March at an altitude of 0–100 m a.s.l., both during daytime and at night, however, the peak of migration activity occurred in April. In all survey months, the highest number of echoes was recorded at an altitude of 0–250 m a.s.l.

Seabird surveys were conducted in the Baltic Power OWF Area (2 NM) and in three additional areas of great significance to birds: the Słupsk Bank, a fragment of the Przybrzeżne wody Bałtyku and the Polish part of the Southern Middle Bank Area.

In the Baltic Power OWF Area (2NM), a total of 19 bird species staying in the sea area were recorded, including 13 species connected to the marine environment and 6 species of water birds rarely encountered at sea away from the coast. The long-tailed duck was definitely the most often recorded species. The presence of the European herring gull and the common guillemot was recorded ten times less often.

In the additional areas, a total of 23 bird species staying in the sea area were recorded, including 15 species connected to the marine environment and 8 species of water birds rarely encountered at sea away from the coast. The long-tailed duck was also dominant in these areas, the velvet scoter and the European herring gull were observed half as often. The results of seabird observations indicated that the Baltic Power OWF Area (2 NM) is not a place of very high concentrations of birds sitting on the water in the period of their most abundant occurrence in the Baltic Sea.

During the spring and autumn migrations, the presence of **bats** over the Baltic Power OWF Area (2 NM) was confirmed. The calls recorded were assigned to three species of bats: the Nathusius' pipistrelle, the soprano pipistrelle and the common noctule. Additionally, since some signals were impossible to assign to a particular species, they were classified as belonging to the Nyctaloid group. The Nathusius' pipistrelle was the most numerous of the bat species. The total number of recordings indicates a low activity of bats over the OWF Area (2 NM) during the migration period.

The Baltic Power OWF Area is located beyond the boundaries of the **protected areas**, including outside the areas of the European Ecological Network Natura 2000. The two nearest Natura 2000 marine protected areas are: at a distance of approx. 9 km – Przybrzeżne wody Bałtyku (PLB990002) and at a distance of approx. 26 km – the Słupsk Bank (PLC990001). At a distance of approx. 20 km away from the Baltic Power OWF Area, a terrestrial-marine Natura 2000 site – Ostoja Słowińska (PLH220023) and the terrestrial site – Pobrzeże Słowińskie (PLB220003) are situated. Within the Ostoja Słowińska site

(PLH220023), the main complex of the Słowiński National Park, including its part located in maritime areas, is situated.

No **wildlife corridors** run across the Baltic Power OWF Area. They are not identified within the entire Baltic Sea.

Biodiversity of the Baltic Power OWF Area does not differ from the typical biodiversity of the Southern Baltic. There are no species present in the Baltic Power OWF Area, which are not at the same time present in other parts of the Southern Baltic.

The results of the environmental surveys demonstrate that the OWF Area is in the majority of cases homogeneous in terms of abiotic conditions. As a result, sections of sea areas with different **natural values** cannot be indicated, apart from the issue of sea area depth. The southern, shallower section of the sea area is characterised by greater concentrations of seabirds (the long-tailed duck and the velvet scoter).

There are no underwater **cultural heritage** objects in the Baltic Power OWF Area. During surveys conducted in the Baltic Power OWF Area, the presence of five shipwrecks, including three so far unidentified, was confirmed.

The Baltic Power OWF Area is characterised by a low degree of use for the purposes of **navigation** and is used to a small extent by recreational vessels.

Activity related to the **fishing industry** is carried out in the Baltic Power OWF Area, conducted mainly by fishing vessels from the ports in Łeba and Ustka. The area of the planned project is characterised by a low fishing productivity. The main fish species caught in this area were the cod and flounder.

In the Baltic Power OWF Area, there are no structures permanently fixed to the seabed. There are also no licenses issued for the prospection, exploration and production of hydrocarbons from subsea deposits.

Within the zone range of potential impact of the Baltic Power OWF on the landscape, there is an area of land along the section of the coast from Ustka in the west to Jastrzębia Góra in the east. Due to the shape of the coastal zone, the Baltic Power OWF structural elements can be seen from the beaches along this section.

22.4 Modelling performed for the purposes of the project impact assessment

For the purposes of this EIA Report, modelling was carried out in order to:

- obtain information on the extent of the suspended solids dispersion and their concentration in the water as a result of the work conducted that disturbs the seabed sediments;
- obtain information on the range and intensity of the underwater noise generated during installation and construction works;
- obtain information on the potential number of collisions of passing seabirds with wind power stations.

On the basis of the results of the seabird inventory, the modelling of their density in the areas surveyed was performed.

The calculations performed concerned the dispersion and content of **suspended solids** which take into account various forcing conditions (wind, currents) and enabled the analysis of the effect of these conditions on specific parameters of the suspended solids impact. The method of performing the calculations enabled the selection of the least beneficial impacts for the environment, i.e. the suspended solids impacts caused by the work related to the construction of the wind farm, which interfere with the marine environment the most. The results of the simulations performed lead to the following conclusions: i) higher suspended solids contents have a local range in relation to the place of the dredging work performance and do not exceed a distance of 1200 m; ii) the thickness of the newly formed sediments at a distance of 1000 m from the site of the work carried out do not exceed 5 mm; and iii) in the least favourable scenario, the average thickness value of the sediment formed due to the work related to the preparation of the seabed for structures will not exceed 1.4 mm in APV and 1.3 mm in RAV within the entire Baltic Power OWF Area.

Underwater noise will be emitted to the environment at each stage of the Baltic Power OWF implementation. However, its greatest impact is expected during construction due to the high level of noise generated during pile driving. The analysis was carried out for the worst-case scenario (piling of the foundation or supporting structure with a diameter of 12.5 m) using the numerical modelling of underwater noise. The sound levels were also estimated taking into consideration the NRS in the form of a big bubble curtain (BBC) placed around the site of pile driving into the seabed.

Moreover, due to the possibility of a situation, in which in a given sea area simultaneous piling will take place in two or more locations, modelling was conducted to determine potential cumulation of noise and its impact on porpoises, seals and fish. On the basis of the estimations conducted, it was found that what is significant for the size of impact is the number of sources and not the distance between them.

With the use of the NRS in the form of a BBC, the impact zones for a single strike decrease significantly. The impact ranges for repeated pile driver strikes during piling are much greater than those obtained for a single strike. The use of the NRS in the form of a BBC significantly reduces the impact range for repeated strikes.

The presence of wind power stations may lead to **collisions** with passing birds. Among all the species considered in the modelling, the significance of the impact resulting from collisions was determined as moderate for the common scoter, geese (including individuals unidentified as to the species) and crane, while for the long-tailed duck and velvet scoter it was low. In the case of other species, the significance of the collision impact was evaluated as negligible.

22.5 Description of the environmental impact anticipated if the project is not implemented, taking into account the available information on the environment and scientific knowledge

The failure to implement the project involving the construction and exploitation of the Baltic Power OWF may require a compensation of the assumed quantity of energy obtained through exploitation of conventional sources with a similar power output, along with the emissions of gaseous and particulate pollutants from combustion of fuels, the generation of approx. 20% of waste from combustion in relation to the amount of the fuel combusted, and indirectly with the effects of environmental changes in the areas where fossil fuels are extracted.

On the other hand, if the project is not implemented, local benefits associated with the abandonment of maritime area development will be obtained. In practice, resigning from the OWF implementation will result in the absence of impacts associated with the construction, exploitation and decommissioning of the OWF elements over a period of several decades. This also entails no access restrictions cornering these areas for the present and potential new users. The impacts on the abiotic and biotic elements foreseen for a different scale and scope will not occur. These elements will be subject to the previous impacts, resulting from the pressures existing in the marine environment.

22.6 Identification and assessment of the project impacts

This impact analysis was carried out separately for the construction phase, the overlapping construction and exploitation phases in the period from 2 to 8 years, as well as the exploitation and decommissioning phases of the OWF.

22.6.1 Applicant Proposed Variant (APV)

22.6.1.1 Construction phase

22.6.1.1.1 Impact on geological structure and seabed sediments

Activities connected with the project construction may cause the following types of impact on the seabed geological structure and sediments: changes in the seabed structure, topography and level, disturbance of the geological structure and changes resulting from the disturbance and sedimentation of suspended solids.

The overall impact of the project during its construction phase was assessed as negligible for the overall character of the seabed and its structure. The changes will be minor, covering a small area of the seabed surface.

In geological terms, taking into account the nature of deposits forming the seabed surface of the Baltic Power OWF Area (1 NM), no significant changes in the character of deposits are expected. Possible changes may occur only locally, where it is necessary to replace weak soil with soil of appropriate parameters, but this will mainly depend on the technology selected. The character of surface sediments will change in the vicinity of individual wind power station locations, and, locally, in places where foundations or support structures are embedded in the seabed. The impact on surface sediments will be negligible.

22.6.1.1.2 Impact on seawater and seabed sediments quality

During the construction phase, the Baltic Power OWF may have the following impacts on the seawater and seabed sediments:

- release of pollutants and nutrients from sediments into water,
- contamination of water and seabed sediments with oil derivatives,
- contamination of water and seabed sediments with antifouling agents,
- contamination of water and seabed sediments by accidental release of municipal waste or domestic sewage,
- contamination of water and seabed sediments by accidentally released chemicals and waste from the construction of the OWF.

Release of pollutants and nutrients from seabed sediments during the construction phase is a direct, negative impact of a local range, short-term or momentary, irreversible, repeatable during the construction period, of low intensity. The significance of this impact during the construction phase in APV was assessed as negligible for sea waters and as low for seabed sediments.

Contamination of seawaters and seabed sediments with oil derivatives released during normal operation of vessels is a direct, negative impact of a local range, momentary or short-term, reversible, repeatable, of low intensity. The significance of this impact during the construction phase in the APV was assessed as negligible both for sea waters and seabed sediments.

Contamination of seawater or seabed sediments with oil derivatives released in an accident is a direct negative impact of regional range, which is short-term, reversible, repeatable, and of high intensity. The significance of this impact during the construction phase in the APV due to the random and sporadic nature of breakdowns and collisions was assessed to be low for sea waters and seabed sediments.

Contamination of seawater or seabed sediments with anti-fouling substances present on vessel hulls during the construction phase is a direct negative impact of local or regional range, which is short-term, reversible, repeatable during the construction period, and of low intensity. The significance of this impact during the construction phase in the APV was assessed as negligible.

Contamination of seawater or seabed sediments with municipal waste or domestic sewage is a direct negative impact of a local range, short-term or momentary, reversible, repeatable during the construction period, of low intensity. The significance of this impact during the construction phase in the APV was assessed as negligible for sea waters and seabed sediments.

Contamination of seawater or seabed sediments connected with the OWF construction process is a direct, negative impact of a local range, short-term or momentary, irreversible, repeatable during the construction period, of medium intensity. The significance of this impact during the construction phase in the APV was assessed as negligible for sea waters and as low for seabed sediments.

22.6.1.1.3 Impact on climate, including greenhouse gas emissions and impacts relevant in terms of climate change adaptation and impact on the air (state of the air)

During the construction phase of the Baltic Power OWF, an increased emission of pollutants into the atmosphere can be expected, due to the increased traffic of vessels involved in the project construction. During this phase, the significance of the planned project impact on climate and greenhouse gases will be negligible as there will be no factors that could have a noticeable impact on their change.

The impact on air quality during the construction phase of the planned project will be temporary and will disappear after the work is completed. Furthermore, since the area is open and unobstructed, pollutant concentrations will decrease rapidly. Therefore, the significance of the impact will be negligible.

22.6.1.1.4 Impact on nature and protected areas

22.6.1.1.4.1 Impact on biotic elements in the maritime area

During the Baltic Power OWF construction phase, no impacts on **phytobenthos** will occur.

During the construction phase of the Baltic Power OWF, works carried out on the seabed will cause the following impacts, affecting the condition of **macrozoobenthos** inhabiting the area: i) disturbance of the seabed sediment structure, ii) increased concentration of suspended solids in water, iii) sedimentation of suspended solids at the seabed, and iv) redistribution of pollutants from sediments into water.

The analysis of the impact present during the Baltic Power OWF construction phase indicated that the impacts were assessed as negligible or of low significance, whereas the most adverse impact will be the disturbance of the structure of seabed sediments in places where the hard bottom macrozoobenthos currently occurs, especially in the southern and north-eastern part of the sea area surveyed.

The main impacts on the **ichthyofauna** will be: i) emission of noise and vibration, ii) increased suspended solids concentration, iii) release of pollutants and nutrients from sediments into water, iv) habitat change, and v) barrier creation.

The impact of noise and vibration on adult fish will be: negative, direct, short-term and reaching beyond the Baltic Power OWF Area. The significance of the impact was assessed as moderate for all the fish species examined.

The increase in suspended solids content will concern relatively small areas in relation to the entire surface of the spawning and feeding grounds. At the same time, the results of modelling of the suspended solids dispersion in the Baltic Power OWF Area indicate that the increase of their content in water will be short-term and local. The impact related to the increase of suspended solids content will be negative, direct, local, and short-term. The significance of the impact is assessed to be negligible for all the fish species analysed.

The impact related to releasing pollutants and nutrients from the sediments into water will be negative, direct, temporary and local. The significance of the impact is assessed to be negligible for all the fish species analysed.

The impact related to the change of habitat will be negative, direct, temporary and local. The significance of the impact is assessed to be negligible for all the fish species analysed.

The impact related to the creation of the barrier will be negative, direct, local and temporary for the cod and European flounder, and long-term and permanent for other fish species. The significance of the impact is assessed to be negligible for all the fish species analysed.

In the construction phase of the Baltic Power OWF, **marine mammals** may be subject to impacts resulting from: i) underwater noise from piling works, ii) noise generated by vessel traffic, iii) increased content of suspended solids in water, iv) habitat changes, and v) spillage of oil derivatives into the environment as a result of vessel failures.

The most significant impact on marine mammals during the construction phase is the emission of underwater noise as a result of foundation pile driving. The use of NRS significantly reduces this impact. The significance of this impact was assessed to be moderate at most.

During the construction phase of the OWF, the space above the sea area where installation and construction works are carried out is gradually disturbed. Both the vessels participating in these works and the OWF structures erected create obstacles for **migratory birds.** Impacts on migratory birds resulting from the barrier effect and collision with the Baltic Power OWF structures were assessed for the exploitation phase, when their effects are the greatest. The significance of the impact of the Baltic Power OWF, i.e. the barrier effect and the risk of collision on migratory birds during the construction phase was assessed to be low at most.

The most significant impacts on **seabirds** during the construction phase included: i) vessel traffic, ii) emission of noise and vibrations, iii) lighting, iv) barrier creation, v) collisions with vessels, vi) destruction of benthic habitats, and vii) increase of suspended solids content in the water and deposition of disturbed sediment. The impact assessment was conducted for the five most abundant bird species: the long-tailed duck, velvet scoter, razorbill, common guillemot and European herring gull.

The significance of the above-mentioned impacts for the European herring gull was assessed as negligible, for the razorbill and the common guillemot as moderate at most, and for the sea ducks (velvet scoter and long-tailed duck) as high.

During the Baltic Power OWF construction phase, impacts on **bats** may occur due to the presence of vessels and a gradual development of the space. As a result, there may be a risk of collision with vessels and structural elements in the development area. Moreover, the presence of vessels will result in the noise level increase and disruptions due to the use of vessel lighting.

The impact on bats identified for the construction phase will be negative, direct, local and short-term, while the significance of the impact was assessed as negligible.

22.6.1.1.4.2 Impact on protected areas

Due to the location of the Baltic Power OWF at a significant distance from the protected area of the Słowiński National Park, there will be no significant impact on this area, including any element for which it was established, such as biodiversity, resources, objects and elements of inanimate nature and the landscape of the Park.

The identification and assessment of impacts on protected areas within the European Ecological Network Natura 2000 is presented in subsection 6.3.

22.6.1.1.4.3 Impact on wildlife corridors

Given the lack of information on the occurrence, functioning and significance of wildlife corridors in maritime areas, it was conservatively assumed that the value of this resource is medium. Taking into account the spatial scale of the Baltic Power OWF Area in relation to the size of the Baltic Sea, including the increasing effect of spatial development, it was assessed that the impact of the Baltic Power OWF on the potential migration routes of migratory species will be negligible during the construction phase.

22.6.1.1.4.4 Impact on biodiversity

Taking into consideration the nature of impacts during the Baltic Power OWF construction phase and the animal species present in that area, including the role that the area plays for them, it can be assumed that at this stage of the project, there may be a short-term change in the number of species present in the Development Area. Individual species may be temporarily scared away to the adjacent areas, in which they will not be exposed to disturbances. However, such movements of individuals do not entail a change in biodiversity at the species level. The operations performed will also not lead to changes at the level of ecosystem and genetic diversity. Therefore, the project impact on biodiversity was assessed as being of low significance.

22.6.1.1.5 Impact on cultural amenities, monuments and archaeological sites and objects

During the construction phase, the Baltic Power OWF will not have a negative impact on the potential objects of great significance for the protection of cultural heritage of the Stone Age. The surveys carried out in the area in question did not reveal any archaeological objects or strata related to the settlement in the Stone Age.

22.6.1.1.6 Impact on the usage and development of the sea area and on material good

Limitations resulting from the gradual exclusion from the previous use of the Baltic Power OWF Area will have the greatest impact on fishing, including in terms of fishing sites, as well as the necessity to extend the routes to the fisheries located north of the Baltic Power OWF Area. The impact on fishing will be negative and direct. Moreover, due to the assumed duration of the construction phase, this impact will be long-term and local.

Taking into account the fact that the previous use of the Baltic Power OWF Area for fishing activities was small and that this activity can be carried out in the neighbouring sea areas, it should be assumed that the significance of the Baltic Power OWF impact on fishing will be low.

22.6.1.1.7 Impact on landscape, including the cultural landscape

During the construction phase of the OWF, the following potential impacts of the project on the landscape, including the cultural landscape, were identified: i) vessel traffic, ii) transport of structural components of the OWF, and iii) gradual erection of the offshore structures.
The impact was assessed as negligible, although it varies depending on the distance of the observer from the OWF and the type of the landscape affected. In the open sea, the landscape is not disturbance-resistant, but its value is not high, as very few people and over a short period will be exposed to the landscape change and some of them may perceive it as advantageous or interesting. The spatial range of the impact will be large, it will decrease as the distance from the OWF increases, the vessel traffic will increase from time to time, and at ports the impact will be local.

22.6.1.1.8 Impact on population, health and living conditions of people

During the Baltic Power OWF construction, the population will be affected at different levels of intensity in onshore and offshore areas. The impact will directly affect the people involved in the construction process. This entire process will be subject to regulations resulting from the occupational health and safety provisions. For the duration of the construction period, fishermen will have to resign from fishing in the area of work and conduct catches in other sea areas. The increased traffic of vessels related to the construction may also affect the safety of navigation.

The scale of impact on the population, health and living conditions of people during the construction phase will be ‘small’ and when assessing the significance of the receptor as ‘very high’, it can be assumed that the significance of the impact will be moderate.

22.6.1.2 Exploitation phase

22.6.1.2.1 Impact on geological structure, seabed sediments, access to raw materials and deposits

Changes within the seabed associated with the project impact will be local and, within the entire area occupied by the project, insignificant for the overall character of the seabed and its structure. No changes in the seabed structure are expected during the project exploitation phase. The overall impact of the project during the exploitation phase can be assessed as negligible.

22.6.1.2.2 Impact on seawater dynamics

As a result of the presence of the Baltic Power OWF construction elements, the velocities and directions of water flow and water pressure in the direct vicinity of each structure may change, which will manifest itself in a local increase in water flow velocity due to the narrowing of the flow stream and formation of whirlpools around the structure. The overlapping of these impacts should not be expected and the disturbances will only be local. The resulting modifications of the wave motion can be noticeable only in the close vicinity of individual wind power stations. However, these are of local nature and should not occur outside the Baltic Power OWF Area. The impact of wind power stations on the wave field and sea current field will be local and will not be of primary significance for these elements.

Significance of the Baltic Power OWF impact on the sea water dynamics in the APV during the exploitation phase was assessed as negligible.

22.6.1.2.3 Impact on seawater and seabed sediments quality

During the Baltic Power OWF exploitation, works affecting the quality of water and seabed sediments will be carried out in its area. These will mainly be service works and interventions in case of an emergency situation. The impacts will be similar to the ones occurring in the construction phase, however, their scale, due to the amount of resources used in both phases of the project, will be several times smaller than in the construction phase.

The new impacts absent in the construction phase will be due to the: i) contamination of seawater and seabed sediments with compounds from anti-corrosion agents and ii) change of seabed sediments and water through the reception of heat from transmission cables.

Contamination of the environment with aluminium or zinc released during exploitation with the use of galvanic cathodic protection is a direct, negative impact of local range, which is long-term, irreversible, permanent, and of medium intensity. The significance of this impact during the exploitation phase in the APV was assessed as negligible for sea waters and seabed sediments.

The increase in the temperature of sediments, in which the cable is buried, and of the interstitial waters filling the spaces between sand grains in the sediment may cause: i) increased bacterial activity, ii) decrease of oxygen content in water, iii) release of harmful substances, including metals, from sediment into water, and iv) adverse effects on benthic organisms. The most important parameters affecting the level of impact are: the depth of cable burying and the type of seabed.

The emission of heat in the sediment around the cables of the Baltic Power OWF will be local and the effect will be imperceptible if the cable is buried deeper than 1 m, which is compliant with the technical assumptions of the project for inner-array power cables, which are to be buried at a depth of maximum 3 m.

Heat emission by the cables is a direct, negative impact of local range which is long-term, irreversible, permanent over the exploitation period, and of medium intensity. The significance of this impact during the exploitation phase in the APV was assessed as negligible for sea waters and seabed sediments.

22.6.1.2.4 Impact on climate, including greenhouse gas emissions and impacts relevant in terms of climate change adaptation and impact on the air (state of the air)

Wind power stations will locally reduce wind energy and disturb atmospheric pressure directly in the area of the rotor operation. The wind power station towers may locally disturb the velocities and directions of water flows and reduce the energy of sea waves, which is reflected in their height drop.

During the exploitation phase, the direct and local impact of the planned project (related to the use of vessels and fuel consumption by them) will not have a significant impact on the change of climatic conditions. Despite the impact being long-term, its range will be local. However, indirectly, the exploitation of the wind farm will result in the reduction of greenhouse gas emissions to the atmosphere by other sources, e.g. coal-fired power plants located in other areas of the country. Therefore, despite the significant importance of the climate and air quality and the small scale of the Baltic Power OWF impact in the APV during the exploitation phase, it may be concluded that the impact in terms of greenhouse gas emissions from vessels to the atmosphere will be negligible.

22.6.1.2.5 Impact on systems using EMF

It follows from the exploitation of offshore wind farms so far that the operation of wind power stations and certain types of tower structures may adversely affect the operation of offshore and onshore navigation support devices or other applications. This applies in particular to radars, communication systems and radiolocation devices.

In accordance with the conditions included in the PSzW permit, the Applicant shall, at the stage of preparing the construction design, provide relevant expert opinions and make arrangements with the relevant users (Border Guard, Ministry of National Defence, and maritime administration) to implement countermeasures required for accepting the impact of the Baltic Power OWF on communication and radio location systems by them. Therefore, it should be assumed that the significance of the impact of the Baltic Power OWF on these systems will be negligible.

22.6.1.2.6 Impact on nature and protected areas

22.6.1.2.6.1 Impact on biotic elements in the maritime area

During the exploitation phase, support structures of wind power stations and the accompanying infrastructure located under the water surface in the euphotic zone may be overgrown by macroalgae. Despite the fact that **phytobenthos** does not occur in the area of the planned OWF, macroalgae spores may appear in this area due to various natural and anthropogenic factors.

Macroalgae and animal organisms (e.g. mussels) overgrowing the OWF components create the “artificial reef”, a factor causing a local increase in the biodiversity of plant and animal species *per se* and indirectly affecting the increase in the species richness and quantitative resources of the marine fauna – mainly fish and nekton crustaceans, which will search for food and places convenient for a refuge and reproduction within it. Therefore, the effect of the underwater OWF structures overgrowth with macroalgae should be considered as positive, however it should also be noted that the natural character of the maritime area will be disturbed. The functioning of the marine ecosystem will be changed locally and in the long term, for which the anthropogenic factor will be responsible. The significance of the impact was assessed as positive and negligible.

The exploitation of the Baltic Power OWF will result in the following impacts on the **macrozoobenthos**: i) loss of a part of the habitat, and ii) “artificial reef” effect.

The main impact in this phase of the project implementation will be the loss of a part of the macrozoobenthos habitat. The seabed development will eliminate biological life from the surface of the seabed, which will be in the worst-case scenario occupied by the GBS with the largest base diameter from among the proposed types of support structures with a protective layer against scour.

The loss of a part of the habitat is a negative impact occurring during the exploitation phase.

Taking into consideration the moderate scale of the impact on the soft bottom macrozoobenthos, the significance of this impact will be low.

Taking into account the high regeneration capacity of the hard bottom macrozoobenthos resources, this impact was assessed as insignificant.

Once the support structures are introduced into the environment, taking into account the high reproductive potential of macrozoobenthos, the colonisation of artificial hard substrates by animal periphyton communities, as well as mobile epifauna – the “artificial reef effect” should be expected there. It will partially compensate for the destroyed macrozoobenthos complex occurring there before human interference in the environment. The “artificial reef effect” is a long-term and permanent phenomenon, but due to its local range, its impact was assessed as moderate.

During the Baltic Power OWF exploitation phase, the impacts on **ichthyofauna** will result from: i) emission of noise and vibration, ii) habitat changes, iii) barrier creation, and iv) EMF emissions.

The impact of noise during the OWF exploitation phase should be much lower than the one observed during construction and decommissioning. It will depend on the environmental conditions (depth, type of sediment, seabed morphology) as well as the type and size of the wind power station and wind speed.

Emission of noise and vibrations generated during the OWF exploitation may directly and negatively affect the ichthyofauna. These impacts will be of negative, direct, local, long-term and permanent nature. The significance of the impact was assessed to be negligible for all the fish species analysed.

The presence of structural elements of wind power stations involves the creation of additional hard substrates forming a new habitat. Such artificial structures form an "artificial reef" – a new habitat After just a few months, numerous populations of fish appear in the reef area, both those returning after the disturbances related to construction have ceased and those not occurring in this area so far, which affects the increase in biodiversity. The process of formation of a stable artificial reef system usually takes from 1 to 5 years.

Moreover, the introduction of possible restrictions on fishing and shipping in the Baltic Power OWF Area will decrease the anthropogenic pressure, and the artificial reef areas may be a specific refuge for fish, both adult and their early developmental stages. However, it cannot be ruled out that artificial reefs may create an environment that also favours non-native fish species.

The impact related to the change of habitat will be positive, direct, local, permanent and long-term. The significance of the impact is assessed to be negligible for all the fish species analysed.

The construction of underwater structures may constitute a migration barrier for commercially important fish, the routes of which run in this location. The impact related to the creation of a barrier will be negative, direct, local, long-term and permanent. The significance of the impact is assessed to be negligible for all the fish species analysed.

The sensitivity of ichthyofauna to the impact of electromagnetic field depends on: i) the species-specific detection threshold, ii) the type of receptor in fish (magnetic, electrical), and iii) the species lifestyle (demersal, pelagic).

The impact related to the emission of EMF will be negative, direct, local, long-term and permanent. The significance of the impact is assessed to be negligible for all the fish species analysed.

During the Baltic Power OWF exploitation phase, the impacts on **marine mammals** will result from: i) emission of noise generated by wind power stations, ii) emission of noise generated by vessels, iii) changes in habitat, iv) vessel collisions, and v) collisions with vessels.

The most significant impact on marine mammals during the Baltic Power OWF exploitation phase will be due to the potential vessel collisions and in consequence due to a significant spillage of fuel. In this case, the significance of impact was assessed as moderate. In the remaining cases, the significance of impact was assessed as low.

During the Baltic Power OWF exploitation phase, the impacts on **migratory birds** will result from two elements, i.e. the barrier effect and the risk of collisions with the OWF structures. Due to the largest assumed occupation of space above the Baltic Power OWF Area, the size of these impacts will be higher than during the construction phase.

The significance of the impact of the barrier effect was assessed as negligible for all species of migratory birds. While the significance of the impact in the form of the risk of collision was assessed as moderate for geese (unidentified as to the species), as low in the case of the long-tailed duck and velvet scoter, and as negligible for other species.

The following were classified as the most significant impacts on **seabirds** in the exploitation phase: i) vessel traffic, ii) disturbance and displacement from habitats, iii) barrier creation, iv) collisions with power stations, v) formation of an artificial reef, and vi) creation of a closed sea area. The impact assessment was conducted for the five most abundant bird species: the long-tailed duck, velvet scoter, razorbill, common guillemot and the European herring gull.
The significance of the above-mentioned impacts for the European herring gull was assessed as negligible, for the razorbill and the common guillemot as moderate at most, and for the sea ducks (velvet scoter and long-tailed duck) as high at most.

The potential impact of the Baltic Power OWF on **bats** during the exploitation phase will be caused by: i) collisions with wind power stations, ii) emission of noise and light, iii) barrier effect, and iv) habitat change. The significance of the Baltic Power OWF impact during the exploitation phase was assessed as low.

22.6.1.2.6.2 Impact on protected areas

Due to the location of the Baltic Power OWF at a significant distance from the Słowiński National Park, during the exploitation phase, there will be no significant impacts on this area, including on any element for which it was established, such as biodiversity, resources, objects and elements of inanimate nature and the landscape of the Park.

As a result of the actual impact assessment of the Baltic Power OWF, it can be stated that the planned project will not cause any significant impacts on the Natura 2000 sites analysed.

22.6.1.2.6.3 Impact on wildlife corridors

Due to the same reasons concerning the knowledge about wildlife corridors in maritime areas and the spatial scale of the Baltic Power OWF Area in relation to the size of the Baltic Sea, including the constant impact of space development, it was assessed that the impact of the Baltic Power OWF on migration routes of migratory species during the exploitation phase, similarly as during the construction phase, will be negligible.

22.6.1.2.6.4 Impact on biodiversity

During the Baltic Power OWF exploitation phase, structures permanently submerged in water will be founded in the environment, creating favourable conditions for the development of animal and plant periphyton organisms. On a local scale, within the range of structural members, there will be an increase in species diversity, although the character of natural value of this habitat may be ambiguous. This is due to the fact that, on the one hand, periphyton communities will be a new biocenosis component of this area, additionally increasing the food supply for fish, birds and, incidentally, for marine mammals. On the other hand, this location may facilitate the spread of non-native species, which lowers the ecological quality of this micro-habitat.

An artificial reef creates favourable living and reproduction conditions for many fish species. Biodiversity also can be positively affected by the long-term restriction or suspension of fishing in the Baltic Power OWF Area. The impact of the “artificial reef” effect will be only local and will not increase biodiversity in a larger area.

In the case of seabirds, as a result of disturbance and displacement from habitats, changes in the distribution of birds in the Baltic Power OWF Area may occur. After a period of disturbance, birds will gradually adopt to the new situation. In the case of species sensitive to the presence of wind power station structures, a visible avoidance of the OWF Area and a resultant decrease in the biodiversity of the area may take place.

22.6.1.2.7 Impact on cultural amenities, monuments and archaeological sites and objects

In the Baltic Power OWF Area no risk of negative impact on the objects of great significance for the protection of cultural heritage of the Stone Age was confirmed. It cannot be excluded that the wrecks reported to the Pomeranian Provincial Monument Conservator in Gdańsk will be put under conservator's protection and will require special avoidance zones to be determined, in which the construction possibilities will be restricted. The Applicant assumes a preventive restriction of activities related to the seabed at a distance of up to 100 m from the wrecks found.

22.6.1.2.8 Impact on the usage and development of the sea area and on material goods

During the exploitation phase, the Baltic Power OWF Area will be excluded from regular navigation due to safety reasons. Decisions on permits for vessels other than the vessels handling the OWF in the Baltic Power OWF Area will be made by relevant maritime administration authorities.

As a result of a maritime area being occupied by the Baltic Power OWF, this area may be excluded from the possibility of fishing. The Baltic Power OWF Area is located unevenly within four fishing squares. This area is characterised by low fishing productivity, therefore the significance of the impact was assessed to be low.

22.6.1.2.9 Impact on landscape, including the cultural landscape

Potential impacts of the project on the landscape, including the cultural landscape, resulting from the presence of offshore structures or vessels, were identified for the OWF exploitation phase.

Objectively, the landscape within the OWF will be industrial, but its impact will also be subjective and will depend on individual characteristics of the person, and may be perceived negatively, as well positively.

The significance of the impacts was assessed as negligible.

22.6.1.2.10 Impact on population, health and living conditions of people

The exploitation of the Baltic Power OWF shall require regular maintenance services. All related work will be conducted by qualified teams of workers and will be subject to strict requirements concerning the occupational health and safety.

Access to the Baltic Power OWF Area may be limited for fishing vessels and may entail, for example, a restricted availability of the fisheries currently exploited and an extension of the routes for fishing vessels from certain ports to the fisheries located north of the Baltic Power OWF Area.

In most weather conditions, the Baltic Power OWF will not be visible from the shore. Only from higher viewing points and under suitable visibility conditions, it will be possible to observe a larger number of wind power stations.

Other types of events that may affect the health and living conditions of people, may involve different types of collisions of vessels at sea. Such events are random by nature, and the presence of the OWF may hinder rescue operations at sea.

Although resources such as population, health and living conditions of people are of great value, due to the fact that the distance of the Baltic Power OWF from the permanent places of residence and work of people is large, the impact of the Baltic Power OWF was assessed as negligible.

22.6.1.3 Overlapping of construction and exploitation phases

When assessing the impact of operations for the overlapping construction and exploitation phases, the highest significance of impacts from among the ones adopted in the assessments for the construction and exploitation phases was assumed. In every case assessed, the significance of impacts for the overlapping construction and exploitation phases was not higher than the significances of impacts adopted for the phases assessed separately.

22.6.1.4 Decommissioning phase

During the decommissioning phase, most of the OWF facilities will most likely be removed from the seabed, in accordance with international regulations. These regulations define the conditions for removal of components and systems of wind farms. Decommissioning work should be carried out in such a manner that it does not hinder navigation and does not adversely affect the marine environment. These standards also define exceptional situations, in which there is no obligation to completely remove an OWF infrastructure components. It is possible to leave such structures when, for example:

- the removal of the components is technically impossible or too expensive;
- there is a threat to the life of the OWF decommissioning personnel;
- the decommissioning involves an unacceptable risk of pollution to the marine environment.

In case some components are left on the seabed, appropriate tests and analyses should be performed determining whether or not the remains of the OWF will collide with the vessel traffic and will negatively affect the biotic and abiotic elements of the environment. It must be ensured that the construction elements left will not start to relocate under the influence of waves, tides, currents and storm surges, posing a risk to marine navigation.

The Baltic Power OWF decommissioning process will begin after a few decades. During that time, other experiences from the decommissioning of other OWFs will be acquired. This will enable developing a detailed OWF decommissioning plan taking into consideration all environmental aspects, including the scope of construction elements removal from the environment. There is no doubt that all above-water elements will be removed, transported to land and utilised there. The underwater components will be also removed to a large extent. Most probably, some of the foundations buried in the seabed will remain in the environment, as their complete recovery will involve too much effort and resources and, at the same time, their removal could result in significant environmental impacts.

Assessing the impact of the operations foreseen for the Baltic Power OWF decommissioning phase, no higher significances of those impacts on particular environmental elements assessed were found than the ones established for the construction or exploitation phases.

As a result of the Baltic Power OWF decommissioning process, the state of biocenotic balance established during the several decades of the exploitation phase will be disrupted. The removal of construction elements from the water will lead to the elimination of a substrate for the development of periphyton flora and fauna. The periphyton communities inhabiting these constructions will be destroyed. This applies in particular to the plant organisms, which were absent from the Baltic Power OWF Area without the OWF structures. Ultimately, depending on the scale of decommissioning, a new state of biocenotic balance will be established, more similar to the current state. The natural processes taking place in the Southern Baltic will also affect this balance.

The removal of the Baltic Power OWF structural elements from the maritime space will allow its reuse by the previous users, especially in terms of navigation. The possibility of using this area for fishing will depend on the degree of structural element removal from the water.

22.6.2 Rational Alternative Variant (RAV)

The Applicant Proposed Variant (APV) and the Rational Alternative Variant (RAV) differ in terms of two crucial parameters, i.e. the maximum number of wind power stations and the maximum rotor diameter. This two essential parameters of the Baltic Power OWF can generate various impacts on the environment.

Assessing the impacts on individual environmental elements, no differences in the impact significance were found between the two variants analysed. Only in the case of the impact assessment of collision risk on migratory birds for the exploitation phase, differences were found in the modelling results obtained for the APV and the RAV. The collision modelling indicated an identical or higher risk of migratory birds collisions for the RAV.

22.6.3 Impact assessment on Natura 2000 sites

22.6.3.1 Initial assessment

The general aim of the Ecological Network Natura 2000 sites protection is to maintain or restore the proper conservation status of the species and natural habitats that are under protection and for the protection of which the sites have been designated.

The Baltic Power OWF project is not directly related to or necessary for the management of the Natura 2000 sites. For these reasons, conducting impact assessment with regard to these sites is necessary.

The essential element of the preliminary assessment of the Baltic Power OWF impact on the Natura 2000 sites is to determine whether a given Natura 2000 site is within the range of potential impacts of the Baltic Power OWF.

The main reasons for concluding whether the planned project may have impacts on the Natura 2000 protected area are the distance between this area and the project implementation area and the range of the impacts. Due to the specific nature of the functioning of the Natura 2000 sites and the possible functional connections between these areas, it is also important to locate the project area in relation to the Natura 2000 sites.

The Baltic Power OWF Area is located outside the sites included in the European Ecological Network Natura 2000. Therefore, when determining the impacts of the planned project on the Natura 2000 sites, the impacts which go beyond the Baltic Power OWF Area, were adopted i.e. i) the increase of the suspended solids in the water and their sedimentation, ii) underwater noise and iii) spatial disturbances.

Taking into consideration the fact that the distance between the nearest Baltic Power OWF structures, the source of suspended solids formation, and the protected habitats is several times greater than the maximum range of suspended solids sedimentation, no impacts on such habitats occur in terms of the change of their boundaries, fragmentation or affecting their structure or function.

The Noise Reduction System, which is an integral part of the Baltic Power OWF during the construction phase, is indented to reduce the underwater noise generated during pile driving, so that it does not exceed the TTS values within the Natura 2000 sites boundaries, in which such organisms are subject to protection. It is assumed that in the case of other OWFs, in order to avoid significant impacts on the Natura 2000 sites, the condition for the implementation of such projects will be to maintain the levels of underwater noise that are safe for the species subject to protection in such areas, within the boundaries of these areas.

As a result of the preliminary impact assessment of the planned project on the Natura 2000 sites, taking into consideration the scope and nature of impacts, it was indicated, both for the Baltic Power OWF, as well as for the cumulative impact of impacts generated by other projects, that no Natura 2000 site is situated within the range of the following impacts: i) increase of the suspended solids in the water and their sedimentation and ii) underwater noise. Lack of such impacts relates in particular to the subjects of protection (species and habitats) within these areas, for the protection of which they have been established.

The main impact assessment of the Baltic Power OWF on Natura 2000 sites covered the aspect related to the probable impact caused by the disturbance of the airspace over the Baltic Power OWF Development Area, in the context of integrity of the Przybrzeżne wody Bałtyku site (PLB990002) and the coherence of the Natura 2000 network.

22.6.3.2 Main assessment

The main assessment, due to the nature of impact, was focused on the exploitation phase of the Baltic Power OWF. In this phase, the airspace above the maritime area will be maximally occupied by the structures both of wind power stations and platforms, thus, the impact will be the greatest in comparison to the other phases of the project.

In the context of the protection of seabird populations within the Natura 2000 network, the following are important features of the areas of the Słupsk Bank (PLC990001) and the Przybrzeżne wody Bałtyku (PLB990002): i) location of these areas along the bird migration routes, ii) appropriate habitat conditions, and iii) availability of these areas for the populations of wintering birds and birds resting during migration.

In the context of maintaining the coherence of the Natura 2000 network, first of all, it is important to maintain the possibility of movement for seabird populations between the areas, without the risk of significant population depletion or significant energy expenditures, which could affect the ecology and biology of these populations.

Although the availability of the Baltic Power OWF Area for the populations of wintering birds and birds resting during migration which are the subject of protection in the neighbouring Natura 2000 sites will be restricted, the impact was assessed as negligible for the long-tailed duck and the European herring gull, and the impact for the black guillemot and the common scoter will be absent. Moreover, the existence of corridors (areas with no developments) west and east of the Baltic Power Development Area and between the Baltica 2 OWF and the Baltica 3 OWF will significantly increase the flight possibility for the birds migrating within the area of wind farms in this region.

Due to the location of the Baltic Power OWF, the issue of the impact of the planned project on the integrity of the Natura 2000 site could be considered in the context of the nearest Natura 2000 site, i.e. the Przybrzeżne Wody Bałtyku site (PLB990002). No significant, negative impacts of the Baltic Power OWF, resulting in the displacement of the bird species that are subject to protection within the Przybrzeżne wody Bałtyku (PLB990002) from their habitats, are expected.

As a result of the main assessment of the Baltic Power OWF impact on the bird species the subject of protection in the Słupsk Bank (PLC990001) and the Przybrzeżne Wody Bałtyku (PLB990002) sites, on the integrity of the Przybrzeżne Wody Bałtyku site (PLB990002) and the coherence of the Natura 2000 network, it can be concluded that the planned project, both in the APV and in the RAV, will not cause any significant impacts on the Natura 2000 sites analysed.

22.7 Cumulative impacts of the planned project (taking into account the existing, being implemented and planned projects and activities)

The assessment of the cumulative impact of the Baltic Power OWF implementation in connection with other projects included the existing, implemented and planned projects. In the case of the planned projects, only those for which an environmental decision had been issued, were taken into account.

No other projects that may cause cumulative impacts are being implemented nor will be implemented in the Baltic Power OWF Area. The implementation of the OWF in all its phases, due to the correct and safe functioning of this project, prevents carrying out other activities in the same area. Therefore, the impacts that may possibly accumulate with the impacts of the Baltic Power OWF will have their sources outside its area.

22.7.1 Projects existing, being implemented and ones for which the decisions on environmental conditions have been issued

In the Polish Maritime Areas, there are projects in progress and planned projects related to the extraction of hydrocarbons and gas from under the seabed. Their distance from the Baltic Power OWF and the different nature of these projects, are the reason why there will be no cumulative impacts during their implementation.

At present, decisions on environmental conditions have been issued for four projects related to the construction of OWFs and the connection infrastructure in Polish Maritime Areas, which indicates that within a few years their construction phase may begin. The projects are at different stages of progress, therefore, the dates of the construction works commencement and their detailed schedules are unknown. The possibility of the cumulative impact occurrence at the construction stage, due to the time limitation of the impacts themselves, may take place only when the work of the same nature is carried out simultaneously or after a short time interval.

After the completion of the construction phases, the exploitation phases of individual OWFs will begin. Finally, the beginning of the exploitation phase at the last of the Investors will generate the highest possible cumulative impact, resulting from the cumulation of individual impacts indicated for this phase of the project.

In the case of the OWF decommissioning phases, both the time and the scale of their implementation are currently unknown. With the OWF lifetime assumed, the decommissioning phases will start in several decades. The environmental impacts associated with this phase will be of a different nature and will be significantly smaller than in the case of the construction and exploitation phases. As a result of the commencement of the removal of the above-water structures, the space will be gradually reclaimed until the original condition is restored.

22.7.2 Types of impacts which may cause cumulative impact

The cumulation of impacts of the Baltic Power OWF with other projects implemented in the Polish Maritime Areas may occur, if the activities generating similar impacts are carried out simultaneously. In the case of impacts that have been classified as temporary, simultaneous implementation of the same activities by different investors should be considered rare. The impacts that have been identified as local will not cause cumulative impacts, as in most cases their range will not extend beyond the Baltic Power OWF Area.

The impacts of the Baltic Power OWF that may cause cumulative impacts with other projects (other OWFs: Bałtyk III, Bałtyk II, Baltica 2 and Baltica 3) include the following impacts resulting from: i) underwater noise, ii) increase in the concentration of suspended solids and their sedimentation as well as iii) spatial disturbances, including: barriers to the free movement of birds, disturbances in landscape and in the operation of radars as well as restrictions on fishing. The first two of the impacts indicated will occur during the construction phase, while the third one will occur during the exploitation phase.

22.7.3 Cumulative impacts assessment

22.7.3.1 Underwater noise

As far as the underwater noise is concerned, the modelling results of various possible scenarios regarding simultaneous piling indicated the range of impact, including possible accumulation of impacts. At the same time, these results show that in no case these will be significant impacts, provided that only two simultaneous piling operations are performed in the area of all OWFs.

22.7.3.2 Increase in suspended solids concentration and their sedimentation

The modelling results for the suspended solids impact on the environment indicate that the dredging works conducted simultaneously in two, 3 km apart, locations on the foundation of support structures, do not affect each other in terms of suspended solids interaction in the case of work conducted in non-cohesive soils and have a minimal effect in the case of cohesive soils.

22.7.3.3 Spatial disturbances

22.7.3.3.1 Creation of physical barrier

Within the Baltic Power OWF and at other OWFs, a partial, long-term reduction in the use of airspace will occur. The nature of the development, with significant distances between individual OWF structures and with areas between OWFs free from development, will create a discontinuous and uneven spatial disturbance. This unevenness will also occur within the structures themselves. The greatest spatial disturbance will occur within the operating range of the rotor, i.e. more than 20 m above the water surface.

Taking into account the significance of the potential cumulative impact of the OWF on migratory birds, three other OWFs, the implementation of which is very probable, i.e. the FEW Baltic II, C-Wind and B-Wind, were also taken into account for the assessment of these impacts, in addition to those OWFs, for which the decisions on environmental conditions had been issued.

The assessment results of the cumulative impact on migratory bird species indicate that in most cases the significance of this impact will be negligible and only in the case of the long-tailed duck and the common scoter it will be low.

22.7.3.3.2 Landscape disturbances

Landscape disturbances in the case of cumulative impacts related to the simultaneous exploitation of OWFs, depend mostly on the weather conditions – visibility and the Earth curvature. As in the non-cumulative scenario, the impact was assessed as negligible, although it varies depending on the distance of the observer from the OWF.

22.7.3.3.3 Interference in the operation of systems using EMF

The need to perform actions to compensate for the disturbances in the operation of systems using electromagnetic fields indicates that the impacts of the Baltic Power OWF and other OWFs on these systems should be considered only as hypothetical, which will not actually occur.

22.7.3.3.4 Fishing

The development of wind energy in Polish Maritime Areas will change the use of sea area by its current users, in particular, in the context of fisheries.

The presence of the above-water structures will cause two possible types of impacts resulting from spatial restrictions, i.e.: the lack of the possibility of conducting catches within the OWF Area and the necessity to by-pass the OWF on the way to and from the fishing grounds located north of the OWF. In the case of transmission infrastructure, in its immediate vicinity, fishing, in particular using bottom trawls, will not be possible either.

The movement of fishing vessels conducting catches using set gear may cause conflicts with the existing users of the fishing grounds, where the number of gear deployed will increase. No excessive concentration of set nets should be expected after moving the catch effort from the area covered by the OWF. With this in mind, the significance of the cumulative negative impact of the relocation of the fishing fleet can be considered of little importance.

The creation of a barrier to the free passage of fishing vessels shall constitute a negative impact of the OWFs presence in the neighbouring locations. The location of other wind farms east and west of the Baltic Power OWF, without designating a navigation corridor for vessels, will extend the route of fishing vessels to productive fisheries located north of the OWF in the Słupsk Furrow area. This may result in additional costs, mainly for fishing vessels registered in the ports of Ustka and Łeba, due to the increase in the amount of fuel and travel time to the fisheries.

The significance of the cumulative negative impact related to the necessity to extend the routes of fishing vessels to fishing grounds should be considered moderate. In order to limit the negative impact on fishery in this respect, a corridor of the width necessary to maintain the safety of navigation should be left between the OWFs. In such a case, the significance of the project cumulative impact on fishery may be considered insignificant. Another solution could be to allow the transit of fishing vessels through the Baltic Power OWF Area. Each of those solutions remain the responsibility of the appropriate Maritime Office Director.

22.8 Transboundary impact

The Baltic Power OWF Area is located in the Polish EEZ. The distances of this area to the boundaries of the EEZ of other countries are as follows: i) over 58 km from the Swedish EEZ, ii) 100 km from the Danish EEZ, iii) over 85 km from the Russian EEZ, iv) over 189 km from the German EEZ.

The impact assessment conducted for individual elements of the environment indicates that their scope will be local. Only in three cases, the impact of the Baltic Power OWF has been identified as regional in scale. This refers to the impact of: i) underwater noise during the construction phase on adult fish, ii) underwater noise during the construction phase on marine mammals, iii) the barrier effect on birds during the exploitation phase.

The underwater noise analysis carried out for the purposes of the EIA Report for both fish and marine mammals showed that the range of significant impact determined using TTS values do not exceed the boundary of the Polish EEZ.

Almost all species passing through the Baltic Power OWF Area are birds covering long distances between nesting sites and wintering grounds or birds moving locally. This means that the barrier effect and the risk of collision affect birds that spend at least part of their lives in north-west Russia and Scandinavia. Additionally, some of the species exposed to the impact are included in Annex I to the Birds Directive or included in the Natura 2000 protected areas program in the neighbouring countries, and therefore, the impacts of the Baltic Power OWF may affect the abundance of birds which are the subject of protection in these areas.

Surveys carried out as part of the inventory of migratory birds indicate that the impacts of the barrier effect and the risk of collision for the vast majority of species were considered negligible and insignificant. The significance of the barrier effect at the level of a single OWF was assessed to be negligible for all species. The transboundary impact was considered to be at most insignificant.

The significance of the impact of the risk of collision for the crane was assessed as moderate. It will not affect the population of cranes nesting and wintering in other Baltic countries. With periodic shutdown of individual wind power stations during intensive passages of cranes the significance of the collision impact on this species was assessed as low.

The predicted mortality resulting from collisions will not pose a threat to the population, which will be able to compensate for the lost individuals as a result of the project impact. In the case of a larger number of OWFs in this area of the Baltic Sea, the accumulated mortality may theoretically exceed the mortality threshold (1887 individuals per year) which allows maintaining the population in good condition, but this will depend to a large extent on the mitigation measures applied in other projects in the vicinity of the Baltic Power OWF. The application of the system for shutting down the elements of the Baltic Power OWF will allow to minimise the impact of this project on the migration of cranes.

The OWF Area is a place of periodic (winter season) concentrations of the long-tailed duck, the velvet scoter, the razorbill and the European herring gull, as well as the common guillemot in the summer period. The nearest Natura 2000 site, Przybrzeżne wody Bałtyku, is an important wintering ground for the long-tailed duck and the velvet scoter. It can be assumed that the birds appearing at the planned project location come from this site. In comparison with the Baltic populations, the size of the long-tailed duck, velvet scoter and razorbill population in the Baltic Power OWF Area is small. There is no data on the size of the Baltic population of the European herring gull. However, the presence of this species is strongly dependent on fishing activity. No transboundary impacts of the Baltic Power OWF are expected.

It is necessary to apply mitigating measures in the form of leaving an area free from development between the OWF areas. This will allow maintaining the continuity of migration routes between wintering grounds and minimising transboundary impacts in the context of cumulative assessment on seabirds.

22.9 Analysis and comparison of the variants considered and the variant most favourable for the environment

Taking into account the PSzW decision issued for the Baltic Power OWF, it would be unjustified to consider another location variant of the planned project. Therefore, both the APV and the RAV were considered for the same area.

The differences between the APV and the RAV were based on the existing and the technological solutions feasible in the coming years, resulting from the intensive development of OWE. The maximum installed capacity of the Baltic Power OWF, i.e. 1200 MW, was adopted as the limit parameter in both options considered. Therefore, using power stations with higher capacity, it becomes possible to erect a smaller number of wind power stations.

The RAV assumes wind power stations of 5 MW capacity in the analyses. Taking into account the maximum installed power of the Baltic Power OWF, in this variant, it would be necessary to construct 240 wind power stations. With the wind power station capacity of 9.5 MW assumed in the APV, the maximum installed power will be achieved already after the construction of 126 wind power stations.

Construction and exploitation of a smaller number of wind power stations as part of the APV in relation to the RAV, means, consequently, less interference in the environment as a result of: i) shorter duration of the construction and decommissioning phases, ii) lower number of risky lifting and offshore operations, iii) lower consumption of construction materials and consumables. Also during the OWF exploitation phase, a smaller number of wind power stations as part of the APV will require a smaller number of maintenance and operation activities in relation to the RAV, and consequently, it will contribute to a smaller environmental impact.

A significant difference indicating that the APV compared to the RAV will have a smaller impact on the environment is the issue of the risk of migratory birds collision with the wind power station structures. The results of collision modelling indicate that in most cases this risk is higher for the RAV and in no case is it lower. Given the long-term nature of this impact (several decades of exploitation phase is assumed), these differences are an important reason to indicate that the APV is a more environmentally beneficial option than the RAV.

Comparing both variants, including, in particular, the resulting possible environmental impacts, it should be indicated that the APV is the most beneficial variant for the environment.

22.10 Comparison of the technological solutions proposed with the technological solutions meeting the requirements referred to in Art. 143 of the Environmental Protection Law

Pursuant to Article 143 of the Act of 27 April 2001 – Environmental Protection Law, the technologies used in newly commissioned systems should meet certain requirements which are advantageous for the environment.

Due to the technological specification as well as special conditions of operation in the marine environment, offshore wind farms require these conditions to be verified at the stage of their planning and designing.

The structural elements of the OWF shall be made of materials neutral to sea water and seabed, including the ones resistant to erosion, corrosion or chemical compounds that may appear in the water. Efficiency of energy generation and transmission will be one of the basic criteria determining the most important parameters of the Baltic Power OWF, including the selection of turbines and their distribution within the area as well as cable routes distribution. The overriding criterion of energy efficiency is its generation, with obvious limitations related to the windiness of the area, without the consumption of energy resources – in a fully renewable manner. In the case of renewable energy, the actual efficiency of energy use involves non-returnable energy consumption for the production of the OWF components and their installation at sea.

The consumption of water, materials, raw materials and fuels will take place during the construction and decommissioning phases of the OWF elements. During the period of exploitation, wind power stations will require the use of consumables and fuels during servicing.

The emissions and their range will primarily concern the acoustic impact associated with the operation of wind power stations. They will not affect marine organisms significantly nor cause noticeable electromagnetic interactions.

Experience regarding the use of wind power stations in maritime areas will enable the installation of the most efficient and proven solutions meeting the requirements of the most advanced technologies.

22.11 Description of the prospective actions to avoid, prevent and reduce negative impacts on the environment

The environmental impact assessment carried out for the Baltic Power OWF shows that there will be no significant negative impacts as a result of this project implementation. Nevertheless, impacts of lesser significance are unavoidable. Hence, the rational measures to avoid, prevent and limit the negative environmental impacts resulting from the implementation of the Baltic Power OWF project, are presented below broken down into individual phases.

The mitigation measures proposed for the construction phase include:

- beginning of piling using the so-called soft-start procedure to allow fish, birds and marine mammals to leave and move away from the work site area;
- piling carried out in the period from August to March under the supervision of ornithologists. If the ornithological supervisors do not observe the presence of the common guillemots, razorbills, long-tailed ducks and velvet scoters in the area with a radius of 2 km from the piling site, the work may begin, preceded each time by the soft-start procedure;
- building further power stations beginning from one location, so that the sea area designated for the project is filled with structures gradually, extending the OWF Area by the adjacent power stations;
- simultaneous piling in a maximum of two locations (to reduce noise), regardless whether the two sources are located within the Baltic Power OWF Area or one of them is in the area of a neighbouring OWF;
- intensification of the pace of construction works in the months of March–September, when the number of birds in this sea area is the lowest;
- limiting sources of strong light directed upwards at night; this mainly concerns the periods of bird migration. The Applicant declares that they will limit the light emission to the necessary level, resulting from the applicable regulations and work safety standards.

The mitigation measures proposed for the exploitation phase include:

- painting the blade tips bright colours, which should increase the likelihood of the operating wind power station being noticed by the flying birds. The Applicant declares that the painting of the blade tips will be carried out in accordance with the industry standards and will be agreed with the appropriate authorities;
- illumination of the power stations during night-time conditions through the installation of small, weak and pulsating light sources. Constant, bright lights and pulsating white lights increase the risk of collision. It is also proposed to change the lighting during the limited visibility conditions from continuous to pulsating lighting with a long interval. The Applicant declares that they will limit the light emission to the necessary level, resulting from the applicable regulations and work safety standards;
- equipping the OWF with a system allowing for a short-term shut-down of selected wind turbines during bird migration periods in the case when the results of operational monitoring

indicate that an intensive migration of cranes at the collision height takes place over the OWF Area;

- abandonment of the use of lattice structures of wind power station towers (not applicable to foundations or supporting structures), due to the greater probability of collisions between birds and power stations of such structure (less visible to birds from a longer distance).

The mitigation measures proposed for the decommissioning phase include:

- the removal of subsequent power stations beginning from one location, so that the sea area occupied by the OWF is cleared from the structures gradually;
- maximising the pace of dismantling works in the months of March–September, when the number of birds in this sea area is the lowest.

22.12 Proposal for the monitoring of the planned project impact and the information on the results available for another monitoring, which may be important for establishing the responsibilities in this field

22.12.1 Proposal for the monitoring of the planned project impact

Due to the length of the construction process, and the possibility of a staged introduction of particular parts of the OWF into operation, and hence, the overlapping of the construction and exploitation phases, the schedules of individual monitoring surveys have been described in a continuous manner, indicating three clear points of the project implementation, i.e. i) the beginning of construction, ii) the beginning of exploitation and iii) the completion of construction.

During the implementation of the Baltic Power OWF, monitoring surveys will be carried out on: i) underwater noise, ii) ichthyofauna, iii) migratory birds, iv) seabirds, v) marine mammals, vi) benthic organisms and vii) bats.

The detailed methodologies of the monitoring surveys will be presented to the Regional Director for Environmental Protection to be agreed before the survey beginning.

22.12.2 Information on the results available for another monitoring, which may be important for establishing the responsibilities in this field

As part of the State Environmental Monitoring a range of monitoring surveys of the environment is conducted within the Polish Maritime Areas. Those monitoring surveys cover the physico-chemical parameters of water and sediments as well as biological parameters. The results of these monitoring surveys are collected and made available by the Chief Inspectorate for Environmental Protection.

The Ministry of Maritime Economy and Inland Navigation collects data on the volume of fish catches carried out in Polish Maritime Areas. The analysis of these data will enable in the future the assessment of the planned project impact on fisheries.

In the long term perspective, for which the implementation of the Baltic Power OWF is planned, the survey results obtained as part of the monitoring and the information on other activities carried out in the sea areas can be used to monitor the project impact on the environment. This is due to the fact that the scope of these monitoring surveys and information covers those elements of the marine environment which the planned project may affect directly and indirectly. The lengthy series of surveys, will allow to eliminate from the assessment the short-term changes in the environment resulting from the complex marine ecosystem characteristics, and not being the consequence of the planned project impact.

22.13 Limited use area

This EIA Report has indicated that at the current stage of the project preparation there are no grounds to determine the probability of exceeding the environmental quality standards either for air, noise, wastewater and EMF which will not exceed the maximum permissible values outside the area, to which the Applicant holds a legal title.

22.14 Analysis of possible social conflicts related to the planned project, including the analysis of impacts on the local community

The period of informing about the planned Baltic Power OWF is 2011 and the following years, when: i) the Applicant submitted a request for issuing the PSzW and obtained the decision of the Minister of Maritime Economy on the permit for the construction and use of artificial islands, structures and devices in the Polish Maritime Areas and ii) the basic documents defining the spatial policy of the country and region have been adopted. That decision and the provisions of the planning documents envision the implementation of offshore wind energy as part of the National Power System.

The projects of strategic documents along with environmental impact forecasts were subject to the public participation procedure along with social consultations conducted by the competent administrative authorities prior to their adoption under the provisions of the Act on spatial planning and development.

Target groups to conduct information meetings with have been selected taking into account a number of criteria: the nature of the project, location, potential impacts of the planned project and the type and degree of interest of various social groups presented for other investments at sea.

The following aspects related to the Baltic Power OWF, which may cause social conflicts as well as potential positive changes caused by the planned OWF, were identified.

The potential conflict is underpinned by the following issues:

- depending on the provisions of the maritime administration, the difficulties for the fisheries in the sea area occupied by the OWF, resulting in a restricted access to the area, and therefore, impediments to unconstrained fishing and transit through the OWF Area should be expected;
- incompatibility of the objectives and interests of the parties, the objective indicated by the fishermen community is fishing and transit through the OWF Area to further fishing grounds, as well as ensuring the presence of fish in the Baltic Sea,
- the disruption in the environment that the planned OWF may cause.

The potential stakeholders are:

- public administration and state institutions;
- local government units and institutions;
- trade organisations, including fishing organisations;
- national, regional and local associations and organisations;
- non-governmental environmental organisations;
- potential suppliers, partners, other offshore investors;
- scientific, research and design units.

As part of the development of this report, in March 2020 two information meetings with the representatives of fishermen organisations were held. Formal consultations will be carried out during the environmental impact assessment procedure conducted by the Regional Director for Environmental Protection. The participants of the consultation meetings pointed out many problems of various significance, including environmental issues. The results of the consultations were used during the development of this report on the environmental impact of the OWF.

22.15 Indication of difficulties resulting from technical shortcomings or gaps in the state of the art encountered during the preparation of the report

The identification of the elements of the environment, which may be influenced by a wind farm in the Polish Maritime Areas, is patchy. Some aspects, especially the biotic ones, are better identified, e.g. the occurrence of zoobenthos, and for some the information is scarce, e.g. the presence of bats over the maritime areas. The surveys conducted for the purposes of the EIA Report enabled the provision of more detailed information concerning the environment in the area of the planned project. This allowed developing a comprehensive environmental inventory, both in terms of abiotic and biotic elements.

There is no information on the potential impacts of the OWF, especially during the exploitation phase, for example, in terms of the phenomenon of underwater structure overgrowth, environmental effects of an artificial reef or behaviour of birds encountering above-water structures during passages. So far, no wind power stations have been erected in the Polish Maritime Areas. Therefore, there is no experience nor detailed knowledge based on the results of studies on the impact of this types of projects.