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BC-WIND OFFSHORE WIND FARM

REPORT ON THE ENVIRONMENTAL IMPACT

ASSESSMENT OF THE

BC-WIND OFFSHORE WIND FARM

Applicant **C-WIND POLSKA Sp. z o.o.**



Contractor **MEWO S.A.**



Subcontractors **Maritime Institute
Gdynia Maritime University**



**National Marine Fisheries
Research Institute**



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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; fitted aboard all ships of 300 gross tonnage and upwards. 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	C-Wind Polska Sp. z o.o.
APV	Applicant Proposed Variant
Baltica 2	Baltica 2 Offshore Wind Farm
Baltica 3	Baltica 3 Offshore Wind Farm
Bałyk II	Offshore Wind Farm Polenergia Bałyk II (previously Bałyk Środkowy II)
Bałyk III	Offshore Wind Farm Polenergia Bałyk III (previously Bałyk Środkowy III)
BBC	Big Bubble Curtain – underwater noise reduction system
BC-Wind DA	BC-Wind OWF Development Area
BC-Wind OWF Area	the area of the BC-Wind 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 (ref. no. GT7/62/115904/decyzja/2012) and the permit no. MFW/4/13 of 6 February 2013 for the construction and use of artificial islands, structures and devices, issued by the Minister of Transport, Construction and the Maritime Economy (ref. no.: GT7/62/1172655/decyzja/2013)
BHD	Backhoe Dreger – type of a dredger
BIAS	Baltic International Acoustic Survey
BirdLife International	international non-governmental organization 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)
EM	electromagnetic field
epifauna	group of invertebrates 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 the 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
GRS80H	geodetic coordinate system
H_01	the monitoring point located in the centre of the OWF Area (1 NM) at a depth of 44.6 m
Habitats Directive	Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (OJ EU 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)
Hz	hertz – unit of frequency where 1 Hz equals 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
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 (infauna), 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 of the 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)
MSPPSA	Maritime Spatial Plan of Polish Sea Areas
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
NMSS	National Maritime Security System
NOAA	National Oceanic and Atmospheric Administration
NOVANA	programme 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
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 the 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 BC-Wind OWF Area including the 1352 m wide zone around it, with the total surface of 170.58 km ²
OWF Area (2 NM)	marine survey area covering the BC-Wind OWF Area including the 3204 m wide zone around it, with the total surface of 298.3 km ²
OWF DA	Offshore Wind Farm Development Area – an area where the construction of offshore wind turbines is planned along with substations, accommodation and service platforms, research and measurement platforms (including measurement masts) as well as the installation of electricity grid and telecommunication networks
OWPS	Offshore Wind turbines
P VSDP	Pomeranian Voivodeship Spatial Development Plan
PAH	Polycyclic Aromatic Hydrocarbons
PCB	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
PL-1992	national flat rectangular coordinate system
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)
POP	Persistent Organic Pollutants
PORP	Pomeranian Office for Regional Planning
ppm	parts per million

PSE	Polskie Sieci Elektroenergetyczne S.A.
PSzW	permit 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/4/13	permit of 6 February 2013 for the construction and use of artificial islands, structures and devices, issued by the Minister of Transport, Construction and Maritime Economy to B-Wind Sp. z o.o. (ref. no.: GT7/62/1172655/decyzja/2013)
PSzW no. MFW/7/12	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 C-Wind Sp. z o.o. (ref. no.: GT7ak/62/1165094/decyzja/2012)
PTS	Permanent Threshold Shift in animals
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
PW-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)
RAV	Rational Alternative Variant
RCS	Radar Cross Section – the effective surface reflection of radar waves
RES	Renewable Energy Sources
resuspension	repeated disturbance 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: <i>Rzeczpospolita Polska</i>)

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
sea ducks	ducks of the Mergini tribe
SECA/ECA	Sulphur Emission Control Areas / Emission Control Areas
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
SM4M	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 the 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)
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 – numerical atmospheric model for Poland
UNCLOS	United Nations Conventions on the Law of the Sea
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)
WoRMS	World Register of Marine Species
zoobenthos	invertebrates inhabiting the seabed sediments both on the surface and inside

1 Introduction

1.1 Preface

This document constitutes the Environmental Impact Assessment Report for the B-Wind and C-Wind Offshore Wind Farms (hereinafter referred to as: BC-Wind OWF).

The investor applying for the determination of the conditions for the implementation of the project in question is C-Wind Polska Sp. z o.o. with its registered seat in Warsaw at Al. Jerozolimskie 98, 00-807 Warsaw, entered under into the register of entrepreneurs under KRS no.: 0000396848, REGON: 221531686, NIP: 5862272911. C-Wind Polska Sp. z o.o. is owned by OW Offshore S.L. (<https://www.oceanwinds.com/>), a joint venture between EDP Renewables SA and ENGIE SA. OW Offshore S.L. consolidates all the projects implemented to date and is the exclusive entity for the purpose of implementing EDPR and ENGIE's offshore wind energy projects worldwide. At present (as of 1.10.2021), the company has approximately 1.5 GW of projects under construction and a pipeline of projects with a planned capacity of 4.0 GW under development.

The planned project is the BC-Wind OWF with the maximum total capacity of 500 MW located in the maritime areas of the Republic of Poland, covering the area of 86.28 km², at a distance of approx. 22.6 km from the seashore [Figure 1.1].

The planned project covers the construction, operation and decommissioning of the BC-Wind OWF. It will consist of up to 41 wind turbines, 188 km cable routes and up to 6 other structures.

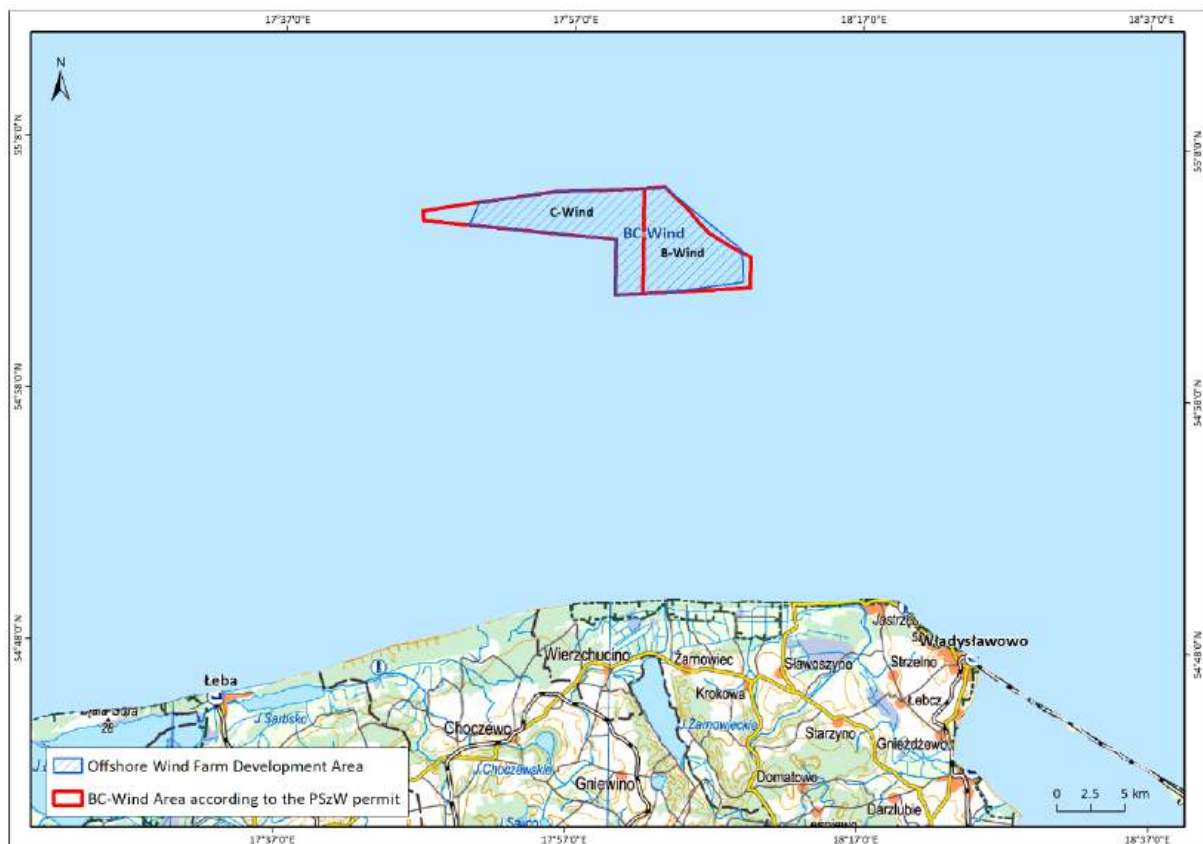


Figure 1.1. Location of the planned BC-Wind OWF project [Source: internal materials]

On 9 May 2012, C-Wind Sp. z o.o. obtained permit no. MFW/7/12 from the Minister of Transport, Construction and the Maritime Economy 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 200 MW oraz infrastruktura techniczna, pomiarowo-badawcza i serwisowa związana z etapem przygotowawczym, realizacyjnym i eksploatacyjnym” [literally: “Complex of offshore wind farms with the maximum total power of 200 MW together with technical, research and measurement and service infrastructure associated with the pre-investment, implementation and operation stages”] (ref. no.: GT7ak/62/1165094/decyzja/2012), while on 6 February 2013 B-Wind Sp. z o.o. obtained permit no. MFW/4/13 from the Minister of Transport, Construction and the Maritime Economy 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 200 MW oraz infrastruktura techniczna, pomiarowo-badawcza i serwisowa związana z etapem przygotowawczym, realizacyjnym i eksploatacyjnym” [literally: “Complex of offshore wind farms with the maximum total power of 200 MW together with technical, research measurement and service infrastructure associated with the pre-investment, implementation and operation stages”] (ref. no.: GT7/62/1172655/decyzja/2013).

On 18 February 2021, C-Wind Sp. z o.o. applied to the Ministry of Infrastructure for a decision on transferring the permit of B-Wind Polska to C-Wind Polska. On 31 March 2021, by way of letter no. GM-DGM-7.530.36.2021, the Minister of Infrastructure issued a decision on the transfer of the permit issued to B-Wind Polska Sp. z o.o. to C-Wind Polska Sp. z o.o.

At the same time, the Investor made plans to enlarge the development area by 2.34 km² in order to achieve maximum electricity production from the planned OWF. Therefore, the Investor will apply for a permit for the construction and use of artificial islands, structures and devices in Polish Maritime Areas for an additional area. Considering the above, the application for the issuance of the decision on environmental conditions covers an additional area, slightly exceeding the boundaries of the PSzW already issued.

Table 1.1 summarises the basic parameters of the planned BC-Wind OWF in the Applicant Proposed Variant (APV).

Table 1.1. The most important parameters of the BC-Wind OWF for the Applicant Proposed Variant [Source: internal materials]

Name of a structure or parameter	Unit	Value
Number of wind turbines (maximum)	pcs.	41
Single wind turbine capacity (minimum)	MW	12
Number of offshore substations and other built features (maximum)	pcs.	6
Length of cable routes of the inner OWF systems (maximum)	km	188

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 BC-Wind OWF, the competent authority is the Regional Director for Environmental Protection in Gdańsk.

The area of the planned project is covered by the Maritime Spatial Plan of Polish Sea Areas, at a scale of 1:200 000, adopted by the Regulation of the Council of Ministers of 14 April 2021 on the adoption of the Maritime Spatial Plan for internal sea waters, territorial sea and the exclusive economic zone, at a scale of 1:200 000 (Journal of Laws of 2021, item 935), hereinafter referred to as the MSPPSA. The BC-Wind OWF Development Area, assumed and described in the following section (subsection 2.1.2), allows for a conclusive statement that it is consistent with the MSPPSA, in particular: it is situated in the sea area 46.E, where the primary function is obtaining energy from renewable sources; it lies 2 NM away from sea areas with the primary function of Transport; and it is situated 4 km away from the Baltic Power OWF, leaving the area free of development available for the movements of migratory birds.

The “Environmental Impact Assessment Report for the BC-Wind Offshore Wind Farm” was prepared by MEWO S.A. in collaboration with subcontractors: Maritime Institute of the Gdynia Maritime University (formerly: Maritime Institute in Gdańsk), National Marine Fisheries Research Institute, IFAO, Marea Sp. z o.o., DHI Polska Sp. z o.o.

1.2 Project classification

The project covered by the application is an offshore wind farm within the meaning of Article 3.3 of the Act of 17 December 2020 on promoting electricity generation in offshore wind farms.

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 § 2.1.5.b, plants using wind energy for electricity generation located in maritime areas of the Republic of Poland are qualified as such).

Being classified as a project that may always significantly affect the environment entails the obligation to obtain a decision on environmental conditions after an obligatory conduct of proceedings regarding the assessment of the project environmental impact.

The environmental impact assessment of the planned project includes:

- a 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;

- supplementing the justification of the decision with the information on public participation and the manner and extent to which the comments and requests made in relation to public participation were taken into account;
- 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 during the public consultation process; this 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 BC-Wind OWF, is an undertaking of Ocean Winds (OW), which is the owner of C-Wind Polska. OW has experience in the construction of offshore wind farms in the UK, Belgium and Portugal. As of 1.10.2021, OW has 0.5 GW of installed capacity at operating facilities and 5.0 GW of secured capacity in projects scheduled for 2021 and beyond, which means a total of capacity of 5.5 GW at facilities in operation and scheduled for development.

Implementation of the project in question 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 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 operation, a 500 MW OWF can produce 55.85 TWh/201.04 PJ of electricity, which would allow to avoid the emission of over 20 million Mg CO₂, more than 273 thousand Mg SO₂, approx. 37 thousand Mg of nitrogen oxides and more than 0.6 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, the 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 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 CO₂ emissions, covers directly two of the three objectives of the European Union in this respect.

The BC-Wind OWF is also in line with the objective of the EU long-term strategy adopted in November 2018 “Climate neutrality by 2050” [222] i.e. achieving zero level of greenhouse gas emissions by 2050 and the idea of the European Green Deal [486].

Electricity from wind farms will be the cheapest source of electric power for the European economy, according to experts’ estimates. Costs of energy from this source will be cheaper by as much as several dozen percent than from the gas energy industry.

1.4 Aim and Scope of the Report

The Environmental Impact Assessment Report was prepared for the purpose of the assessment of the planned project impact on the environment, 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 environments;
- the existing and planned use and development of sea areas;
- other conditions resulting, among other, from specific regulations, 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 operation of the BC-Wind 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 operation as well as decommissioning stages;
- the need to protect people, people’s health and living conditions from negative impacts;
- proposals for environmental monitoring conducted in all phases of the project.

The subject of the document is the analysis of the planned BC-Wind OWF impact 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 62.1 and Article 66.1 of the EIA Act [Source: internal materials based on the EIA Act]

Provision of the EIA Act	Section of the Report
Article 62.1	

Provision of the EIA Act	Section of the Report
Identification, analysis and assessment of direct and indirect environmental impacts of the project	6
Identification, analysis and assessment of the direct and indirect impacts of the project on the population, including people's health and living conditions	6.1.1.8; 6.1.2.10; 6.1.4.9
Identification, analysis and assessment of the direct and indirect impacts of the project on tangible property	6.1.1.6; 6.1.2.8; 6.1.4.7
Identification, analysis and assessment of the direct and indirect impacts of the project on historical monuments	6.1.1.5; 6.1.2.7; 6.1.4.6
Identification, analysis and assessment of the direct and indirect impacts 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 the direct and indirect impacts of the project on the mutual interactions between the elements referred to above	6
Identification, analysis and assessment of the direct and indirect impacts of the project on accessibility 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 as well as 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 the monitoring required	12
Art. 66.1	
Description of the planned project, including:	2
characteristics of the entire project and conditions for the land use during the implementation and operation or use phases, also in relation to the flood risk areas within the meaning of Article 16.34 of the Act of 20 July 2017 – the Water Law	2.4
main characteristics of production processes	2.2
types and quantities of emissions expected, including waste, resulting from the implementation and operation 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 consumption	2.4.6
information on demolition works concerning projects likely to have a significant impact on the environment	2.4.5
the risk of major failures as well as natural and construction disasters, assessed on the basis of scientific knowledge, taking into account the substances and technologies applied, including the risk 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
environmental elements under protection pursuant to the Act of 16 April 2004 on nature protection and wildlife corridors within the meaning of this Act,	3.7.2; 3.7.3
hydro-morphological, physico-chemical, biological and 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 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 vicinity	3.8
Description of the landscape within which the project is to be located	3.10
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 with the planned project	1.7; 7

Provision of the EIA Act	Section of the Report
Description of the effects on the environment predicted in the case the project is not implemented, taking into account environmental information and scientific knowledge available	5
The 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
Rational, most environmentally beneficial variant, along with the justification of the choice	2.3.2; 9
Determination of the environmental impacts predicted for the variants analysed, including the case of a major industrial accident or a natural or construction disaster, as well as impacts on the climate, including greenhouse gas emissions and impacts important in terms of adaptation to climatic changes, and possible transboundary environmental impacts	2.5; 8
Comparison of the impacts of the variants considered on:	6.1; 6.2
people, plants, animals, fungi and natural habitats, water and air	6.1.1.8; 6.1.1.4.1; 6.1.1.4.4; 6.1.1.2; 6.1.1.3
ground surface, including mass movements of the earth, and landscape	6.1.1.1
tangible property	6.1.1.6
historical monuments and cultural landscape, covered by the existing documentation, in particular a register or inventory of monuments,	6.1.1.5
forms of nature conservation referred to in Article 6.1 of the Act of 16 April 2004 on nature conservation, including the objects and subjects of protection of Natura 2000 sites, and the continuity of wildlife corridors connecting them	6.1.1.4.2; 6.1.1.4.2.1; 6.1.1.4.3
elements listed in Article 68.2.2.b, 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 a–f above;	6.1; 6.2
Justification of the Applicant Proposed Variant, taking into account the information referred to in Article 66.1.6 and 6.a of the EIA Act	2.3.2
Description of forecasting methods applied by the Applicant and 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
the existence of the project	6.1; 6.2
the use of natural resources	6.1; 6.2
emissions	6.1; 6.2
Description of the actions planned with an aim to avoid, prevent, limit or environmentally compensate for the adverse impacts on the environment, in particular on the forms of nature conservation referred to in Article 6.1 of the Act of 16 April 2004 on nature conservation, including the impact on the objects 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, operation and decommissioning, respectively	11
If the planned project is related to the use of the installations, the comparison of the proposed technology with the 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
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 61.1 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	13

Provision of the EIA Act	Section of the Report
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	
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 in the phase of its construction and operation or use, in particular on the forms of nature protection referred to in Article 6.1 of the Act of 16 April 2004 on nature conservation, including the impact on the objects 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 technical shortcomings or gaps in the state of the art encountered during the preparation 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 report is authored by a team – the team leader, including the first and last name and the date of report preparation	Before the list of Abbreviations and Definitions
Declaration of the author, and if the report is authored by a team – the team leader, on meeting the requirements referred to in Article 74.a.2 of the EIA Act	Before the list of Abbreviations and Definitions
Sources of information constituting the basis for the report preparation	17

1.5 Report basis

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 200 MW oraz infrastruktura techniczna, pomiarowo-badawcza i serwisowa związana z etapem przygotowawczym, realizacyjnym i eksploatacyjnym" [literally: "The Complex of Offshore Wind Farms with the maximum total power of 200 MW together with technical, research and measurement and service infrastructure associated with the pre-investment, implementation and operation stages" (decision no. MFW/7/12 of 9 May 2012, ref. no.: GT7ak/62/1165094/decyzja/2012),
 - 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 200 MW oraz infrastruktura techniczna, pomiarowo-badawcza i serwisowa związana z etapem przygotowawczym, realizacyjnym i eksploatacyjnym" [literally: "The Complex of Offshore Wind Farms with the maximum total power of 200 MW together with technical, research and measurement and service infrastructure associated with the pre-investment, implementation and operation stages" (decision no. MFW/4/13 of 6 February 2013, ref. no.: GT7/62/1172655/decyzja/2013),
 - Oil Pollution Prevention Plan, MEWO S.A., Maritime University in Gdynia, Gdańsk, 2021,

- Navigational Expertise, MEWO S.A., Maritime University in Gdynia, Gdańsk 2021,
- Expert opinion on the impact on the safety of surveys on identification and operation of mineral resources of the seabed, MEWO S.A., Maritime University in Gdynia, Gdańsk, 2021,
- Documentation containing the results of environmental surveys and inventory surveys carried out in the period from August 2019 to January 2021 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;
- Environmental Impact Assessment Report for the Baltic Power Offshore Wind Farm.

1.6 Findings of 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). In 2009, the European Union Strategy for the Baltic Sea Region (EUSBSR) was adopted, being the first EU macro-regional intra-EU strategy.

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** safeguarding important bird habitats and migration routes in the Baltic Sea from negative effects of wind and wave energy production at sea. The 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 HELCOM Recommendation 34E/1. 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.

Poland is also a signatory to the International Convention on the Control of Harmful Anti-fouling Systems on Ships, signed in London on 5 October 2001 (Journal of Laws of 2008, no. 134, item 851), referred to as the "AFS Convention". The AFS Convention is a framework convention allowing the prohibition on the use of harmful anti-fouling systems on ships, in accordance with clearly defined procedures, having due regard to the precautionary principle expressed in the Rio Declaration on Environment and Development. At this stage, the AFS Convention prohibits the use of organotin compounds on ships.

1.6.2 Documents at national and regional levels

The planned project directly pursues the objectives described in the national and regional documents listed 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 Management Concept 2030 adopted by the Resolution no. 239 of the Council of Ministers on 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 CO₂ 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 defence 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 CO₂ 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.

In the **Polish Energy Policy until 2040** (adopted by way of the Council of Ministers resolution in March 2021), 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 relevant regulations will be prepared to enable the start-up of the first OWF in Poland in 2025, and further development of this technology in Polish conditions as a strategic energy policy project.

The **Strategy for Responsible Development until 2020 (with an outlook until 2030)** also responds to the provisions of the EU's EUROPE 2020 Strategy. It specifies that the modernisation of generation sources and innovative solutions in the economy, along with the development of capacities available 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, resulting in an increase in energy prices. Therefore, the Strategy identified the following as necessary:

- 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 **Development Plan for Meeting the Current and Future Electricity Demand for 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 Economy 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 viable investment plans until 2030 are 6 GW. The document specifies that for the development of offshore wind energy in Poland, it is necessary, among others:

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

The Maritime Spatial Plan for internal sea waters, territorial sea and the exclusive economic zone was adopted by the Regulation of the Council of Ministers of 14 April 2021 (Journal of Laws of 2021, item 935). The regulation became effective on 22 May 2021. The document accounts for PSzW decisions and other official documents issued before the commencement of work on the MSPPSA (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. The planned project is in line with the provisions of the MSPPSA.

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.

Regional documents

The **2030 Pomeranian Voivodeship Development Strategy** adopted by the Regional Council of the Pomeranian Voivodeship by way of Resolution no. 107/221/21 of 4 February 2021 is the main strategic document setting out the directions for the development of the Pomeranian Voivodeship. The Strategy sets three key objectives: Sustainable Security, Open Regional Community and Resilient Economy. They are specified within 12 operational objectives. The planned project contributes to the implementation of the operational objective 1.2. "Energy security" by using the potential of sea areas for the development of renewable energy. The Pomeranian Voivodeship was presented as strongly dependent on external electricity supplies. The development of this sector may result in the creation of numerous jobs, which is referred to, among others, in the above-mentioned operational objective 1.2 "Energy security" (in the context of building new elements of the energy system) and 3.1 "Competitive position" (regarding the use of shipbuilding potential).

The **Pomeranian Voivodeship Spatial Development Plan 2030** was adopted by resolution no. 318/XXX/16 of the Regional Council of the Pomeranian Voivodeship of 29 December 2016. In the field of spatial policy, the focus is, among others, on the growth of electricity production and transformation of the region into the 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: "...the construction of transmission and distribution systems as well as power stations for power evacuation from the new and renewable energy sources systems (wind farms, including offshore...) (...) the extension of 400/110 kV substation Żarnowiec for the possibility of connecting the

offshore wind farms to the National Power System (NPS)..." The Pomeranian Voivodeship Spatial Development Plan 2030 (PVSDP) outlines the vision of spatial transformations of the region. One of the elements of the vision is the thesis that as a result of the 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 findings of 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.**

Table 1.3 refers in detail to the environmental objectives for individual features in the documents indicated, i.e.: the Regulation of the Minister of the Environment of 17 February 2017 on the adoption of a set of environmental objectives for marine waters (Journal of Laws of 2017, item 593); the Resolution no. 170 of the Council of Ministers of 15 November 2018 on granting consent to submit a draft update of the set of environmental objectives for marine waters to the European Commission (M.P. OJ of 2019, item 173); Regulation of the Council of Ministers of 11 December 2017 on the adoption of the National Marine Waters Protection Programme (Journal of Laws of 2017, item 2469) and HELCOM Baltic Sea Action Plan (2007).

Table 1.3. References to environmental targets indicated in the Marine Strategy Framework Directive (MSFD), National Marine Waters Protection Programme and HELCOM BSAP [Source: internal materials]

Feature	Environmental target	Comments
MSFD		
C1 Biodiversity	Reduce or maintain anthropogenic pressure at a level that ensures the maintenance of natural habitats in which the natural biodiversity of biotic elements present is preserved, including fisheries, and habitat protection within Natura 2000 protected areas is ensured	The construction and operation of the BC-Wind OWF will not deteriorate the condition of habitats within Natura 2000 sites
C2 Non-indigenous species	Limit the possibility of spreading of non-indigenous species introduced to the environment as a result of human activities in order to ensure the occurrence of non-indigenous species at levels which do not disturb the structure and functioning of the ecosystem, in particular in relation to individual groups of species, areas particularly vulnerable to introduction and general types of habitats, by taking appropriate actions	If non-indigenous species are identified within the BC-Wind OWF on the basis of monitoring surveys, relevant actions will be taken to remove or minimise the effects of the presence of such species, taking into account the scale of the occurrence and the potential threat to indigenous species, possibly including the removal of non-indigenous species from the environment

Feature	Environmental target	Comments
C3 Commercially exploited fish and shellfish species	The objective is to maintain populations of commercially exploited fish and shellfish within safe biological limits corresponding to natural conditions by ensuring that all commercially exploited fish stocks are exploited at or below the maximum sustainable yield level ensuring that all commercially exploited fish remain within safe biological limits, and by limiting or maintaining the operation of fish stocks at a level which ensures the maintenance of their full reproductive capacity as well as full range of ages and individual sizes	The presence of the wind farm will result in reduced fishing activity in the area, with potentially beneficial effects on commercially harvested fish populations
C4 Food chain	Limit the impact of human activities to the level allowing the ecosystem to reach the state in which all the elements of the marine trophic chain will show a natural and stable level of abundance and diversity, and the productivity of biotic components will guarantee the correct functioning of the trophic web	Given the nature of potential impacts and their scale, the construction and operation of the BC-Wind OWF will not cause disturbance in the food chains within the Southern Baltic
C5 Eutrophication	Maintain the influx of annual loads of nitrogen and phosphorus deposited in the Baltic Sea by rivers and in the form of atmospheric precipitation below the Maximum Allowable Inputs (MAI) determined within the framework of regional agreements (HELCOM), in order to help reduce the concentration of nutrients in the sea to the level not exceeding permissible threshold values which are in accordance with recommendations of the currently applicable national and European Union legal acts, and which guarantee the achievement or maintenance of good environmental status and do not cause negative effects in the form of excessive algal growth, increased concentrations of chlorophyll "a" in the water column, decrease in seawater transparency and the level of oxygenation of the seabed waters, which in turn promotes proper development of pelagic and benthic habitats	The construction and operation of the BC-Wind OWF will not cause the influx of nutrient loads, which might increase the eutrophication, to the ecosystem
C6 Seabed integrity	Reduce the accumulated pressure on the seabed to the level enabling benthic habitats to function close to their natural state	The scale of interference with the seabed (approx. 2.5% of the Development Area) as a result of the BC-Wind OWF construction will not cause any loss of seabed integrity
C7 Hydrographical conditions	Permanent alteration of hydrographical conditions without an adverse effect on marine ecosystems Environmental target: Limit activities altering hydrographical conditions to a minimum which ensures no adverse impact on marine ecosystems and undertake activities aimed at improving hydrographical conditions in permanently altered areas (Regulation 2017)	Bearing in mind that: - the number of OWPS (offshore wind power stations), the distance between them and their distribution; - dimensions and shape of individual OWPS towers; - type and dimensions of foundations or support structures; - flow field characteristics (velocities, prevailing directions, etc.);

Feature	Environmental target	Comments
		seabed relief with particular consideration of surface gradients and natural obstacles, it was demonstrated in the EIA Report that the impact on hydrographical conditions within the BC-Wind OWF will be negligible
C8 Contaminants and their polluting effect	The objective is to maintain the concentrations of contaminants at levels not giving rise to pollution of seawater Environmental target: Reduce or maintain the influx of (hazardous) contaminants from various marine and terrestrial sources, which enter the marine environment, in order to achieve or maintain the concentrations of (hazardous) contaminants in biotic and abiotic elements of the marine ecosystem at levels not exceeding the permissible values, below which the probability of undesirable effects of (hazardous) contaminants on marine organisms is minimal and which are in accordance with the recommendations of the applicable national and international legislation, and which guarantee the achievement of good environmental status (Regulation 2017)	Given the type of the project, the BC-Wind OWF will not release to the environment any substances that may cause its contamination. In case of emergency, appropriate measures will be taken to prevent the spread of such substances and they will be removed from the environment
C9 Contaminants in fish and shellfish intended for human consumption	Reduce or maintain at the present level the influx of contaminants from various marine and terrestrial sources into the marine environment in order to achieve or maintain the concentrations of pollutants in fish and seafood intended for human consumption at the levels not exceeding permissible values, which are in accordance with the standards and recommendations of the existing national and European Union legislation, and which guarantee the safety of consumption as well as the achievement or maintenance of good environmental status	Given the type of the project, the BC-Wind OWF will not release to the environment any substances that may cause its contamination. In case of emergency, appropriate measures will be taken to prevent the spread of such substances and they will be removed from the environment
C10 Marine litter	Reduction of the volume of newly arising solid waste deposited in the marine environment, originating from various terrestrial and marine sources, to the levels guaranteeing the proper functioning of the ecosystem, taking into account its natural resistance, or to the total elimination of the newly arising waste	The BC-Wind OWF will not contribute to the disposal of waste into the marine environment, at any stage of project implementation

Feature	Environmental target	Comments
C11 Underwater noise	The objective is to maintain energy input to marine waters, including underwater noise, at a level that does not adversely affect the marine environment. Environmental target: Achieve underwater noise levels that guarantee the proper functioning of marine organisms by taking measures to reduce the sources and intensity of noise and by defining protection (buffer) zones with a ban on activities constituting sources of noise (Regulation 2017)	Application of a Noise Reduction System during the BC-Wind OWF construction will cause the level of noise emitted to the environment to be not only short-term but also low
National Marine Waters Protection Programme (11 descriptors according to the MSFD)		
Biodiversity food chain – fish	Reduce anthropogenic pressure or maintain it at the present level to ensure the maintenance of natural habitats in which the natural biodiversity of biotic elements present is preserved and habitat protection within Natura 2000 protected sites is ensured	The construction and operation of the BC-Wind OWF will not deteriorate the condition of habitats within Natura 2000 sites
Biodiversity and food chain – marine mammals	Reduce anthropogenic pressure or maintain it at the present level to ensure the maintenance of natural habitats in which the natural biodiversity of biotic elements present is preserved and habitat protection within Natura 2000 protected sites is ensured	The construction and operation of the BC-Wind OWF will not deteriorate the condition of habitats within Natura 2000 sites
Biodiversity and food chain – birds	Reduce anthropogenic pressure or maintain it at the present level to ensure the maintenance of natural habitats in which the natural biodiversity of biotic elements present is preserved and habitat protection within Natura 2000 protected sites is ensured	The construction and operation of the BC-Wind OWF will not deteriorate the condition of habitats within Natura 2000 sites
Biodiversity and seabed integrity – benthic habitats	Reduce anthropogenic pressure or maintain it at the present level to ensure the maintenance of natural habitats in which the natural biodiversity of biological elements present is preserved and habitat protection within Natura 2000 sites is ensured. The aim is to achieve the level of seabed integrity that ensures the protection of the structure and functions of ecosystems, where no negative impacts of human activities are observed, especially on benthic ecosystems	The construction and operation of the BC-Wind OWF will not deteriorate the condition of habitats within Natura 2000 sites
Non-indigenous species	Non-indigenous species introduced to an ecosystem as a result of human activity remain at a level that does not cause adverse changes to the ecosystems	If non-indigenous species are identified within the BC-Wind OWF on the basis of monitoring surveys, relevant actions will be taken to remove or minimise the effects of the presence of such species, taking into account the scale of the occurrence and the potential threat to indigenous species, possibly including the removal of non-indigenous species from the environment

Feature	Environmental target	Comments
Commercially exploited fish and shellfish species	The aim is to maintain populations of commercially exploited fish and shellfish within safe biological limits corresponding to natural conditions by limiting anthropogenic pressures, i.e. setting catch limits that ensure the maximum sustainable yield of the species exploited. The following aims and indicators are based on ICES advice	The presence of the wind farm will result in reduced fishing activity in the area, with potentially beneficial effects on commercially harvested fish populations
Food chain	Discussed under Biodiversity	Given the nature of potential impacts and their scale, the construction and operation of the BC-Wind OWF will not cause disturbance in the food chains within the Southern Baltic
Eutrophication	The Baltic Sea, including the Polish areas of the Baltic Sea, without significant impacts of eutrophication resulting human activity, i.e. the marine environment not threatened by eutrophication caused by limiting the influx of nutrients, i.e. phosphorus and nitrogen compounds from external sources, and maintaining them at the level which does not cause negative changes in the ecosystem in the form of excessive algal blooms, decreased transparency of the sea water, changes in the condition of underwater vegetation and unfavourable oxygenation of near-seabed waters	The construction and operation of the BC-Wind OWF will not cause the influx of nutrient loads, which might increase the eutrophication, to the ecosystem
Seabed integrity	Discussed under Biodiversity	The scale of interference with the seabed (approx. 2.5% of the Development Area) as a result of the BC-Wind OWF construction will not cause any loss of seabed integrity
Hydrographical conditions	Limit activities altering hydrographical conditions to a minimum that ensures no adverse impact on marine ecosystems and undertake activities aimed at improving hydrographical conditions in permanently altered areas	Bearing in mind: - the number of OWPS, the distance between them and their distribution; - 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, it was demonstrated in the EIA Report that the impact on hydrographical conditions within the BC-Wind OWF will be negligible
Contaminants and their polluting effect	Reduce or maintain at the current level the influx of (hazardous) contaminants from various marine and terrestrial sources, which enter the marine environment, in order to achieve or maintain the concentrations of (hazardous) contaminants in biotic	Given the type of project, the BC-Wind OWF will not release to the environment any substances that may cause its contamination. In case of emergency, appropriate measures will be taken to

Feature	Environmental target	Comments
	and abiotic elements of the marine ecosystem at levels not exceeding the permissible values, below which the probability of undesirable effects of (hazardous) contaminants on marine organisms is minimal and which are in accordance with the recommendations of the applicable national and international legislation, and which guarantee the achievement of good environmental status	prevent the spread of such substances and they will be removed from the environment
Contaminants in fish and seafood intended for human consumption	Reduce or maintain at the current level the influx of contaminants from various marine and terrestrial sources into the marine environment in order to achieve or maintain the concentrations of pollutants in fish and seafood intended for human consumption at the levels not exceeding permissible values, which are in accordance with the standards and recommendations of the applicable national and international legislation, and which guarantee the achievement of <i>Good Environmental Status</i> (GES), in line with the RDSM. The concentration of contaminants in fish and seafood intended for human consumption does not exceed the levels established by Community legislation or other relevant standards and does not increase	Given the type of project, the BC-Wind OWF will not release to the environment any substances that may cause its contamination. In case of emergency, appropriate measures will be taken to prevent the spread of such substances and they will be removed from the environment
Marine litter	Reduction of the volume of newly arising solid waste or solid waste deposited in the marine environment, originating from various sources, to the levels guaranteeing the proper functioning of the ecosystem, taking into account its natural resistance, or to the total elimination of newly arising waste	The BC-Wind OWF will not contribute to the disposal of waste into the marine environment, at any stage of project implementation
Underwater noise and other energy sources	Achieve underwater noise levels that guarantee the proper functioning of marine organisms by taking measures to reduce the sources and intensity of noise and by defining protection (buffer) zones with a ban on activities constituting sources of noise	Application of a Noise Reduction System during the BC-Wind OWF construction will cause the level of noise emitted to the environment to be not only short-term but also low
HELCOM BSAP		
Eutrophication	– nutrient concentrations at natural levels, – clean seawater, – algal blooms of natural intensity, – natural distribution and occurrence of plants and animals, – natural levels of seawater oxygenation	The construction and operation of the BC-Wind OWF will not cause the influx of nutrient loads, which might increase the eutrophication, to the ecosystem
Hazardous substances	– nutrient concentrations at natural levels, – all Baltic fish safe for consumption, – healthy wildlife, – radioactivity at the level preceding the Chernobyl accident	The construction and operation of the BC-Wind OWF will not cause the influx of hazardous substances to the ecosystem.
Biodiversity	– natural marine and terrestrial landscapes, – well functioning and balanced plant and animal communities, – viable populations of species	Construction of the BC-Wind OWF will cause a disturbance in the marine landscape; however, for the majority of land-based observers this change will be

Feature	Environmental target	Comments
		of little significance due to the distance from land. The scale and nature of the project will not result in changes to plant and animal communities or populations at the scale of the Southern Baltic

1.7 Information on the links between the OWF and other projects

In the BC-Wind OWF Area, the launch of other OWFs is planned. Currently, six permits for the construction and use of artificial islands, structures and devices in maritime areas in the vicinity of the BC-Wind OWF Area remain in force [Figure 1.2]:

- Baltic Power OWF (permit no. MFW/6/12);
- Bałtyk Środkowy III OWF (Bałtyk III) (permit no. MFW/2/12);
- Bałtyk Środkowy II OWF (Bałtyk II) (permit no. MFW/2a/13);
- Baltica 2 OWF (permit no. MFW/4/12);
- Baltica 3 OWF (permit no. MFW/5/12);
- FEW Baltic II (permit no. MFW/5a/13).

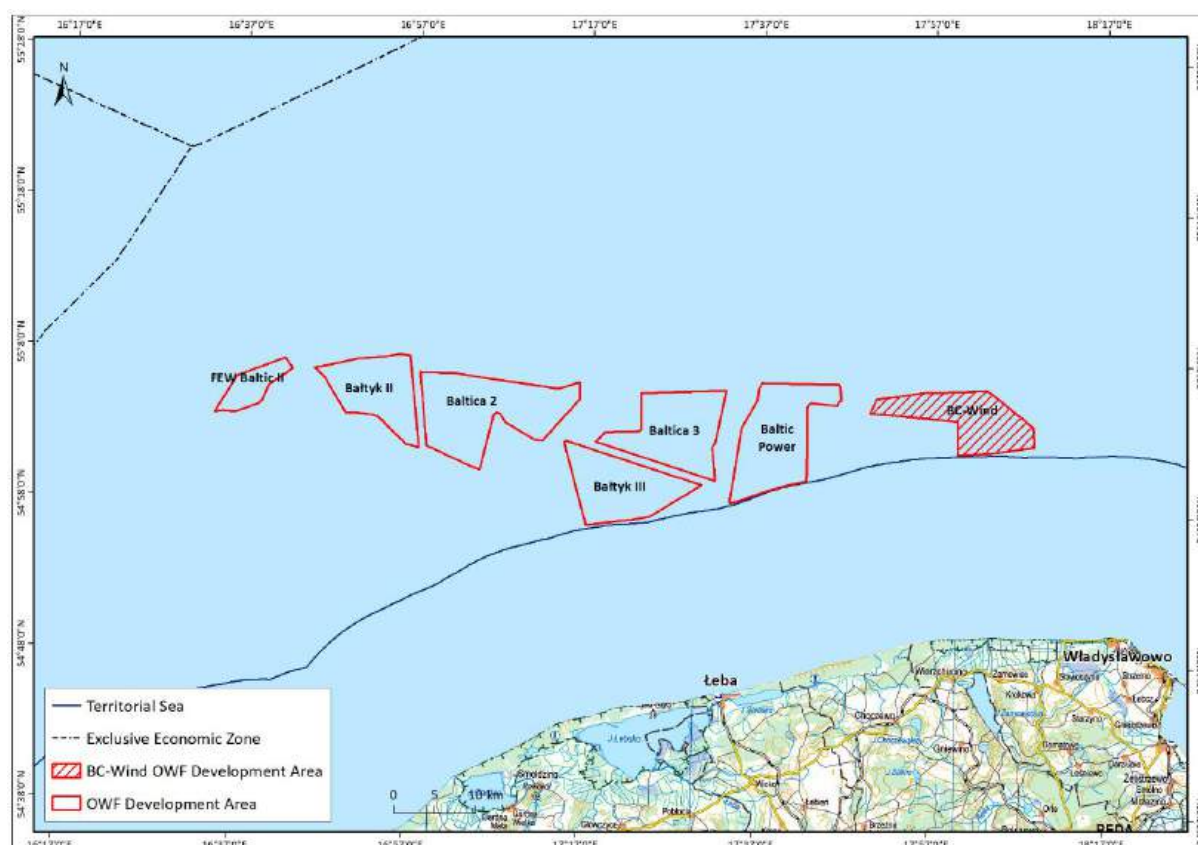


Figure 1.2. Location of the planned OWFs in the vicinity of the BC-Wind OWF Area [Source: internal materials]

At present, none of the above-mentioned projects have been implemented. The projects are at various stages of development. Five of them have obtained a decision on environmental conditions (Baltic Power OWF, Bałtyk II OWF, Bałtyk III OWF, Baltica 2 and Baltica 3 – as the Baltica OWF). In the case of

FEW Baltic II, the EIA Report has been submitted at the Regional Directorate for Environmental Protection (RDEP) in Szczecin.

1.8 Methodology of assessment of the planned project impacts

In preparing this EIA Report, the results of the 2019–2021 environmental surveys and inventory surveys carried out for the BC-Wind OWF were used. The scope of work also included the results of an information meeting with fishermen. These results 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 an environmental impact assessment report, including:

- the use of environmental survey and inventory survey results;
- the provisions of programming and planning documents at the international, national and regional level, as well as the results of environmental impact forecasts of 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 operation phases, operation, and decommissioning, including the identification of environmental hazards and their potential consequences;
- the results of information meetings.

When preparing the EIA Report, the following were primarily used:

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

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

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

The purpose of the EIA Report is to determine the 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 following were primarily analysed:

- technical and technological aspects of the planned project affecting the size of the impact;
- environmental, spatial and social conditions of the planned project;
- variant preparation opportunities (in terms of location, technical, process, organisation opportunities and logistics);
- size and significance of potential environmental impacts;
- possibility of avoiding and reducing adverse environmental impacts;
- 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 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 the projects located closest to the planned project, as part of 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.

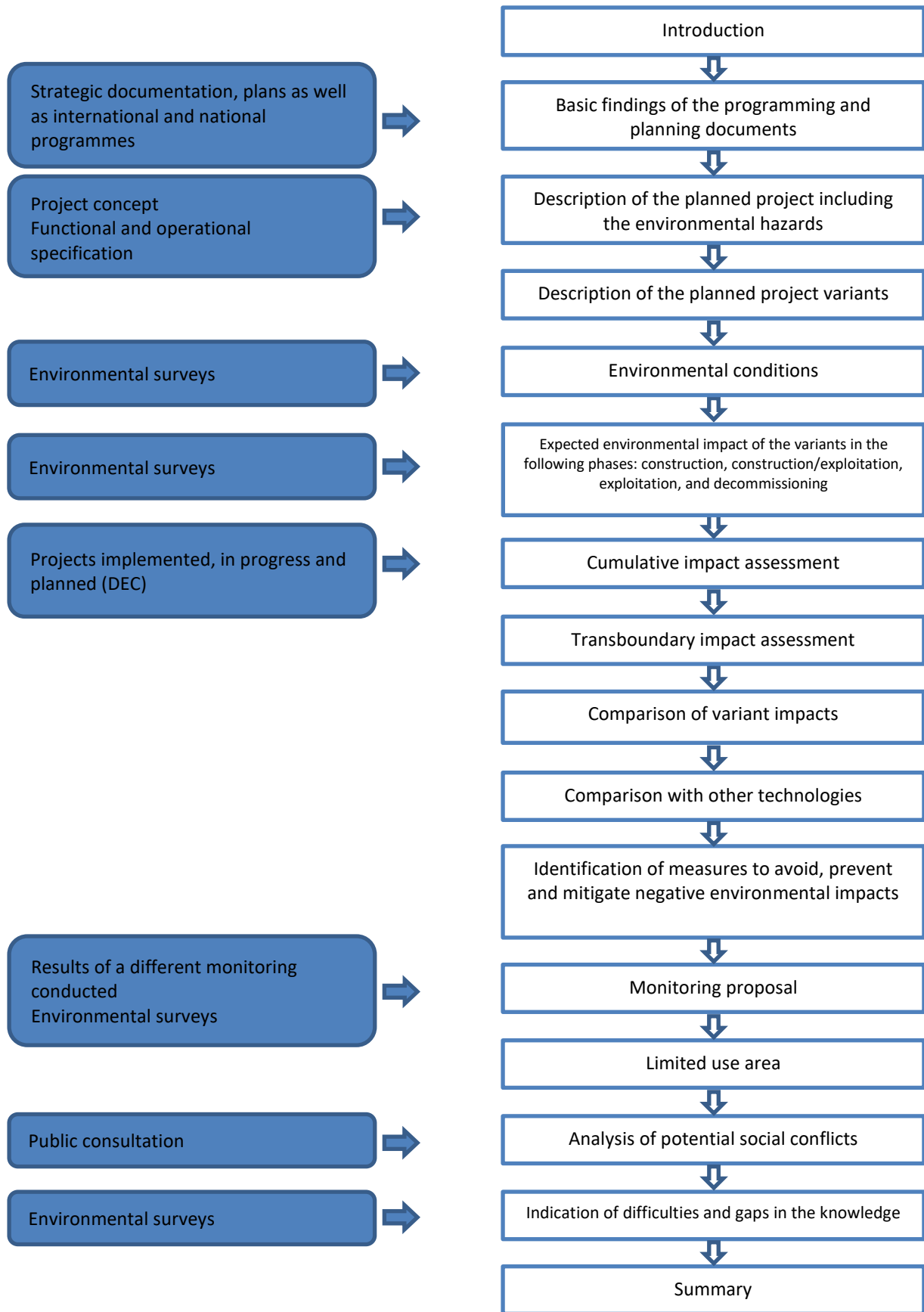


Figure 1.3. Outline of the Environmental Impact Assessment Report preparation [Source: internal materials]

Table 1.4 presents the characteristics of the marine environment surveys, which were carried out for the purpose of the EIA Report preparation. Detailed testing methods for individual elements are presented in the inventory survey reports constituting Appendix 1 to this Report.

Table 1.4. Characteristics of the marine environment surveys of abiotic and biotic elements [Source: internal materials]

Survey type	Survey dates	Survey range	Survey scope
Abiotic elements			
Geophysical surveys	03.2020-06.2020	Area (1 NM)	Profiling (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
Meteorological surveys	10.2019-01.2021	Area (1 NM)	Measurements using a weather buoy to record meteorological conditions. Registration of: • Wind speed and direction; • Atmospheric pressure; • Air temperature and humidity
Hydrological	10.2019-01.2021	Area (1 NM)	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 of: • 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 35 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 groundwater bodies (Journal of Laws of 2019, item 2147)
Geochemical	01.2020-08.2020	Area (1 NM)	Collecting 161 samples of surface sediments (during the winter campaign) and 150 samples of surface sediments (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

Survey type	Survey dates	Survey range	Survey scope
			prepared by an accredited laboratory or applicable test methods
Acoustic surveys	12.2019-01.2021	Area (2 NM)	Ambient noise measurements using 2 hydrophones
Biotic elements			
Phytobenthos	06.2020	Area (1 NM)	Analysis of bathymetric and sonar data. Visual inspection carried out using an ROV along 6 transects. Analysis of video material
Macrozoobenthos	06.2020	Area (1 NM)	Collecting 146 quantitative samples from a soft bottom in an even grid with an average density of 1 sample per 1 km ² . Collecting 10 samples from the hard bottom, including 9 quantitative samples and 1 qualitative sample. Laboratory tests of: • taxonomic composition; • abundance; • biomass
Ichthyofauna	10.2019-07.2020	Area (1 NM)	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. Ichthyoplankton analysis in terms of: • taxonomic composition; • abundance; • larvae and fry lengths
Marine mammals	10.2019-11.2020	Area (2 NM)	Passive acoustic monitoring of porpoises using 5 underwater continuous porpoise detectors (C-PODs). Aerial observations at 5 transects
Migratory birds	08.2019-05.2020	Area (2 NM)	Visual observations, acoustic recordings and recordings using vertical and horizontal radars at 1 station
Seabirds	09.2019-08.2020	OWF Area (2 NM) and the following three areas: Słupsk Bank, Southern Middle Bank, coastal water strip	Counts of birds sitting on the water and in flight along: • 4 transects in the OWF Area (2 NM); • 8 transects in the Słupsk Bank (PLC990001) Natura 2000 site • 6 transects in the Southern Middle Bank Area; • 8 transects in the coastal water strip area
Bats	08.2019-05.2020	Area (2 NM)	Acoustic recording with the use of recorders at 2 stations and along 3 transects with a total length of 55 km

Figure 1.4 presents a diagram with the project environmental impact assessment methodology.

At the first stage, the operations resulting from the implementation of the planned project in its individual phases, i.e. construction, operation and decommissioning, including the phase of overlapping construction/operation, were assessed. On the basis of environmental surveys and inventory surveys conducted for the purposes of the EIA Report, the elements of the environment (receptors) which may be affected by such operations, were also identified. At the second stage of the assessment, the correlations between the sources of potential impacts and individual receptors were identified on the basis of literature and experts' experience.

The impacts identified were assigned characteristics in four categories:

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

At the same time, the resistance of receptors to individual impacts in the cases when a possible interaction between the impact and the 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 was described according to a five-point scale: (1) irrelevant, (2) low, (3) moderate, (4) high and (5) 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-point scale: (1) irrelevant, (2) low, (3) moderate, (4) high and (5) very high.

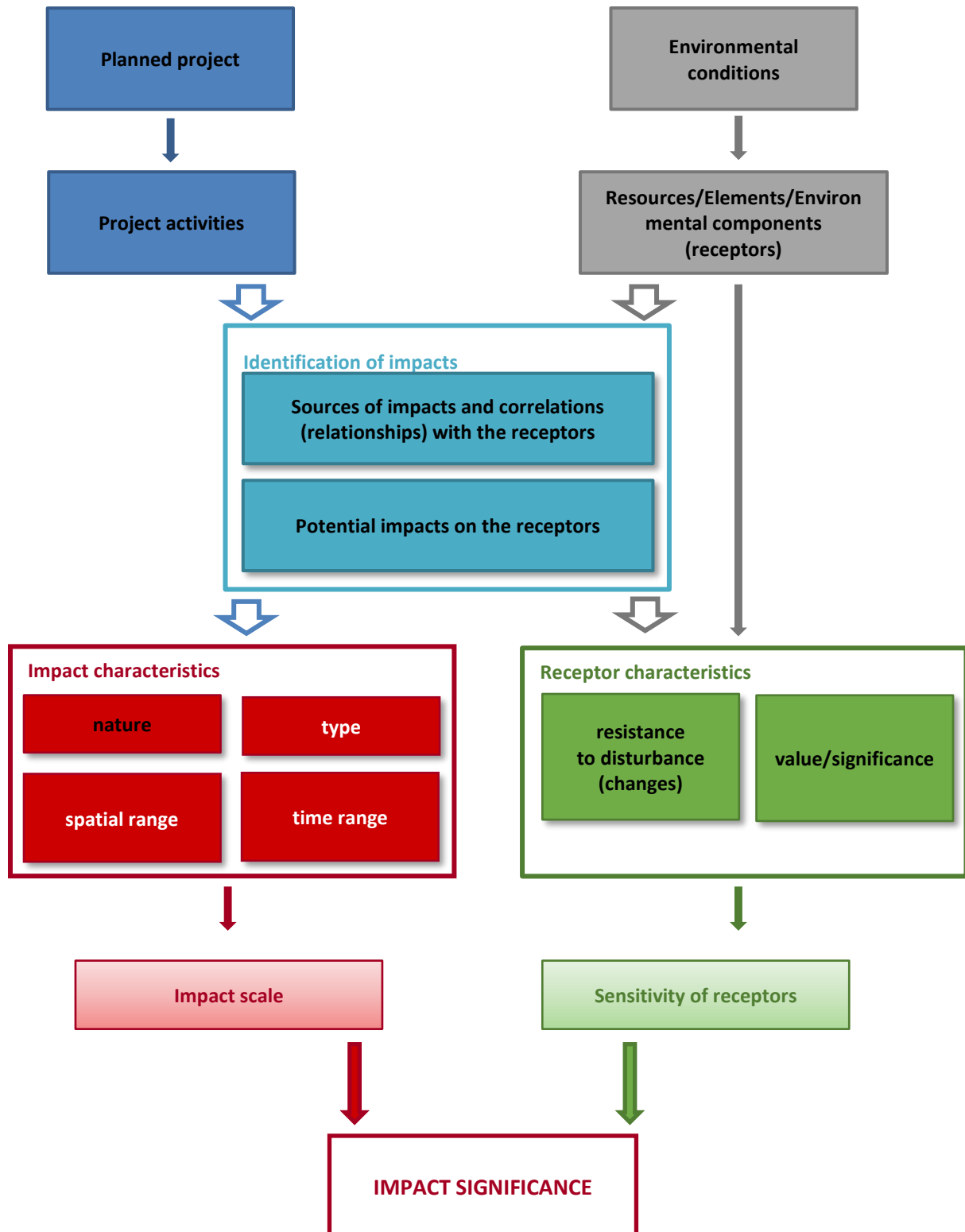


Figure 1.4. Outline of environmental impact identification and impact assessment, including the determination of impact significance [Source: internal materials based on ESPOO REPORT (2017) [118]]

At the next stage of the assessment, taking into account the size (scale) of the impact assigned and the receptor sensitivity, the impact significance was also determined on a five-point scale [Table 1.5]:

- negligible impact;
- low impact;

- moderate impact;
- important impact;
- significant impact.

Table 1.5. Matrix defining the significance of the impact in relation to the scale of impact and the value of the resource [Source: internal materials]

Impact significance		Receptor sensitivity				
		Irrelevant	Low	Moderate	High	Very high
Scale (size) of impact	Irrelevant	Negligible	Negligible	Negligible	Negligible	Low
	Low	Negligible	Negligible	Low	Low	Moderate
	Moderate	Negligible	Low	Low	Moderate	Moderate
	High	Negligible	Low	Moderate	Important	Significant
	Very high	Low	Moderate	Moderate	Significant	Significant

In accordance with the methodology of the environmental impact assessment described above, a significant impact may occur if a “very high” 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 identified.

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 BC-Wind OWF with the total installed capacity not exceeding 500 MW, together with the technical, research and measurement as well as service infrastructure related to the preparatory, implementation and operation phases, located in the Polish exclusive economic zone (EEZ).

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

- wind turbines 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 detailed scope of the project parameters for the APV is presented in 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 capacity (maximum)	MW	500
Maximum number of wind turbines	-	41
Maximum rotor diameter	m	280
Clearance between the rotor operation area and the water surface (minimum)	m	20
Maximum structure height including the rotor	m	330
Maximum number of additional structures	-	6
Diameter of the Gravity Based Structure (GBS) (maximum)	m	60
Seabed surface occupied by a single Gravity Based Structure (GBS) (maximum)	m ²	2826
Length of cable routes in internal wiring (maximum)	km	188

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 extended over 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 turbine and reducing their total number necessary to obtain the assumed OWF power. The existing and currently used wind turbines (with capacities from 3.6 MW to 12 MW) may not be available in production and for use in the perspective of the BC-Wind OWF implementation and the commencement of the first construction phase after 2024. Therefore, the parameters of the project had to be described in such a way that it would allow taking advantage of technological progress in the future and using solutions that are not inferior to those 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 was carried

out for the solution that is potentially the most burdensome to the environment. It was assumed that if the most burdensome solution does not have a significantly negative impact on the environment, the remaining solutions, being 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 the 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 BC-Wind 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 254.1 dB re 1 μ Pa at 1 m from the source) [Appendix 3 to the EIA Report]. 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) are considered by the Investor. Some of the solutions currently used include single and double air bubble curtains, noise barriers or cofferdam systems [27, 305]. 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 BC-Wind 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) [301]:

- 140 dB re 1 μ Pa²s SEL_{cum} HF-weighted (HF-weighting function for marine mammals with high sensitivity to high frequency sounds – porpoise);
- 170 dB re 1 μ Pa²s 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 μ Pa²s SEL_{cum} [344], which will also remain within limits at the boundary of Natura 2000 site Ostoja Słowińska (PLH220023) due to an NRS application.

2.1.2 Project location and the sea area occupied by the project

The BC-Wind OWF Development Area is located in the Polish EEZ, north of Choczewo and Krokowa municipalities, 22.6 km from the shoreline [Figure 2.1]. The BC-Wind Development Area is described by the geographical coordinates indicated in the table below [Table 2.2] and presented in Figure 2.2. The BC-Wind OWF project will be executed as a single operation or in stages within the area indicated in the PSzW no. MFW/7/12 and PSzW no. MFW/4/13, as well as in the north-eastern part of area 46.E, insofar as:

1. it is not limited by the planning requirement to leave 2 nautical miles of free space from sea areas with the primary function of transport (54.T);
2. the distance to the Baltic Power OWF DA is not less than 4 km.

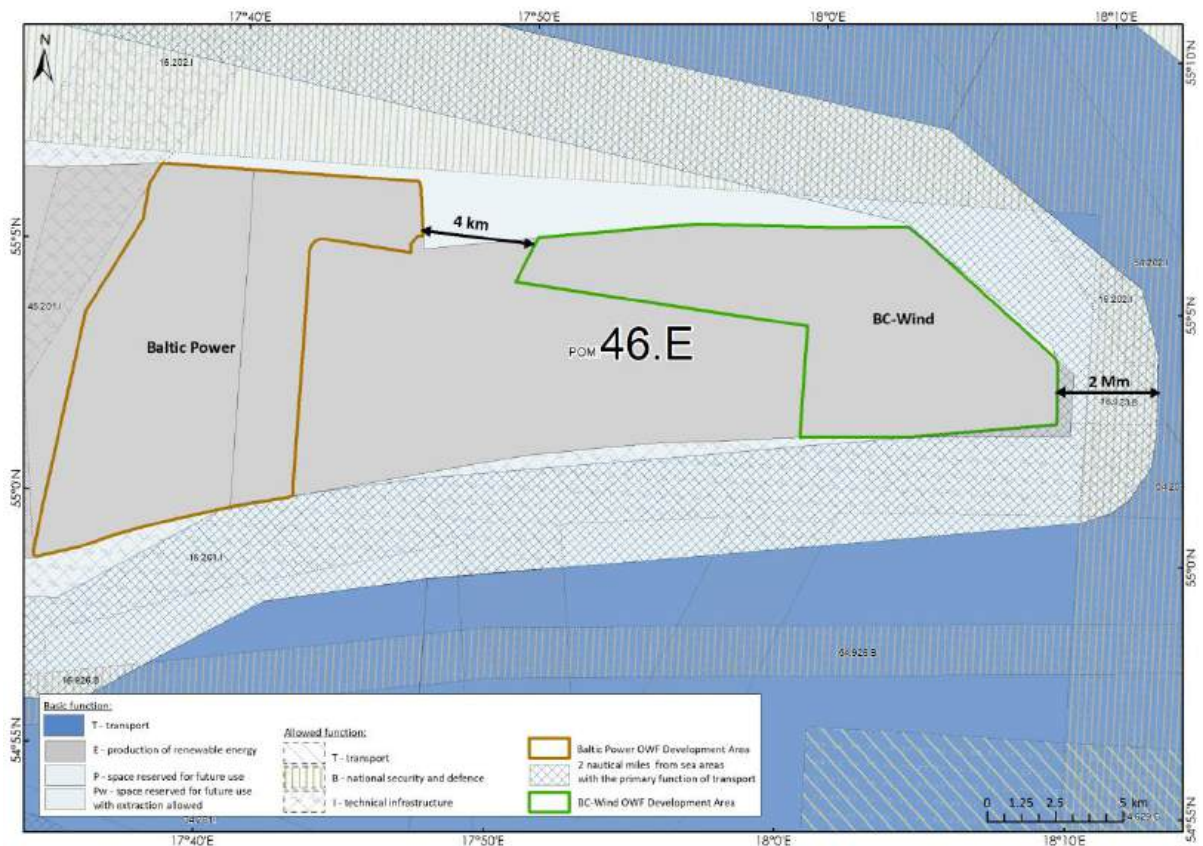


Figure 2.1. Location of the project against the background of the Maritime Spatial Plan for internal sea waters, territorial sea and the exclusive economic zone, 1:200 000 scale [Source: internal materials]

The surface of the BC-Wind OWF Area is 90.94 km², while the surface of the BC-Wind OWF DA is 86.28 km².

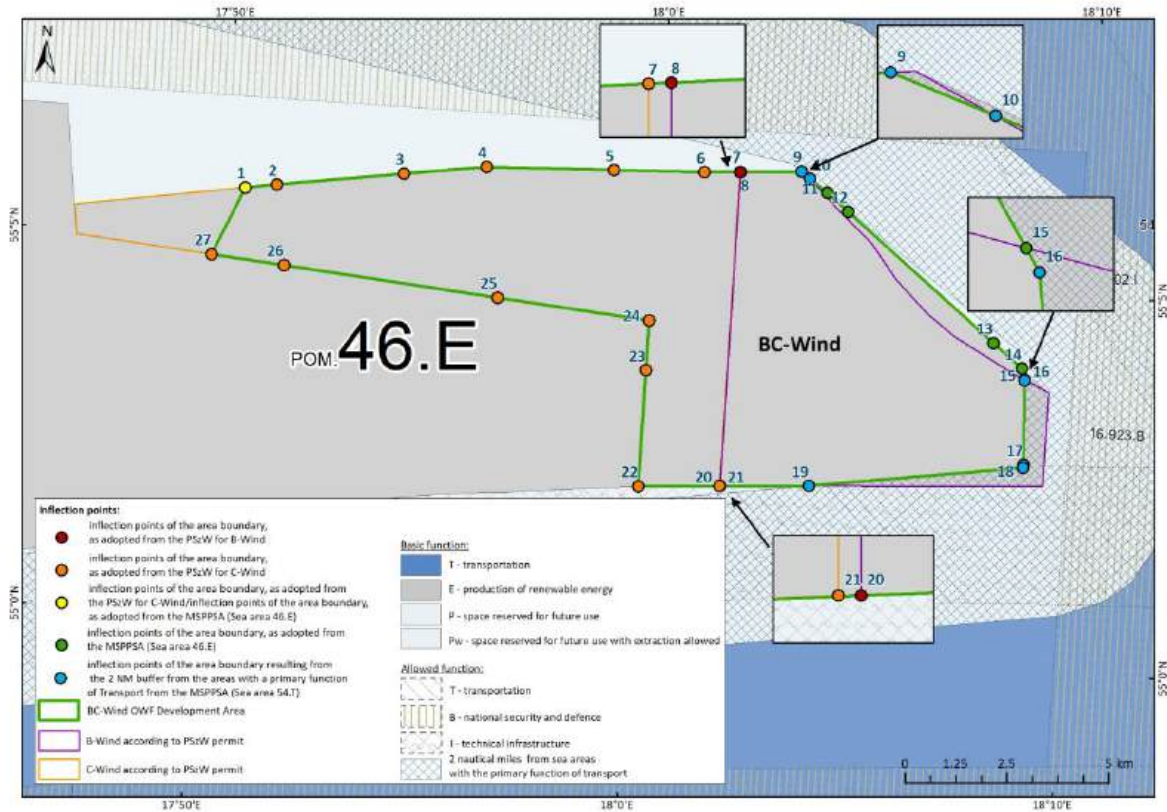


Figure 2.2. Location of the project with reference to the decisions issued: PSzW no. MFW/7/12 and no. MFW/4/2013 [Source: internal materials]

Table 2.2. Geodetic coordinates of the BC-Wind OWF Development Area [Source: internal materials]

Point no.	GRS80H geodetic coordinate system [DD°MM'SS.SSS"]		Comments
	λ	ϕ	
1	17°50'29.701" E	55°05'41.945" N	C, P
2	17°51'12.921" E	55°05'45.974" N	C
3	17°54'07.585" E	55°06'01.656" N	C
4	17°56'01.352" E	55°06'11.346" N	C
5	17°58'58.043" E	55°06'15.594" N	C
6	18°01'03.574" E	55°06'18.656" N	C
7	18°01'52.922" E	55°06'20.769" N	C
8	18°01'53.282" E	55°06'20.785" N	B
9	18°03'17.508" E	55°06'24.392" N	T
10	18°03'30.060" E	55°06'19.193" N	T
11	18°03'55.078" E	55°06'08.831" N	P
12	18°04'25.851" E	55°05'54.849" N	P
13	18°07'58.862" E	55°04'18.065" N	P
14	18°08'40.068" E	55°03'59.343" N	P
15	18°08'44.911" E	55°03'50.593" N	P
16	18°08'45.125" E	55°03'50.205" N	T
17	18°08'50.792" E	55°02'43.042" N	T

Point no.	GRS80H geodetic coordinate system [DD°MM'SS.SSS"]		Comments
	λ	ϕ	
18	18°08'50.365" E	55°02'40.918" N	T
19	18°03'56.238" E	55°02'15.151" N	T
20	18°01'53.405" E	55°02'10.619" N	B
21	18°01'53.045" E	55°02'10.619" N	C
22	18°04'00.360" E	55°02'06.000" N	C
23	18°04'00.360" E	55°03'38.548" N	C
24	18°04'00.359" E	55°04'18.343" N	C
25	17°56'28.930" E	55°04'28.352" N	C
26	17°51'30.273" E	55°04'42.490" N	C
27	17°44'49.441" E	55°04'47.263" N	C

P – inflection points of the area boundary, as adopted from the MSPPSA (Sea area 46.E)

B – inflection points of the area boundary, as adopted from the PSzW for B-Wind

C – inflection points of the area boundary, as adopted from the PSzW for C-Wind

T – inflection points of the area boundary resulting from the 2 NM buffer from the areas with a primary function of Transport from the MSPPSA (Sea area 54.T)

2.1.3 Analysis of compliance with the Maritime Spatial Plan of Polish Sea Areas

On 14 April 2021, the Maritime Spatial Plan for internal sea waters, territorial sea and the exclusive economic zone, 1:200 000 scale, was adopted by the Regulation of the Council of Ministers (Journal of Laws of 2021, item 935).

According to the provisions of the Plan:

- the construction of artificial islands and structures for the generation of energy from wind is only possible in dedicated sea areas with the primary function of *renewable energy generation* – §6.6.1 of the General Provisions¹;
- the function of "renewable energy generation" *refers to the acquisition, processing, transmission and storage, within Polish Maritime Areas, of energy from renewable sources, in particular from wind, wave motion, sea currents, sun and marine organisms (biogas), including the construction of structures necessary for the acquisition and transmission of energy along with the accompanying infrastructure, and of structures intended for energy processing and storage* – §1.3.10 of the General Provisions.

The areas analysed are located entirely in the sea area POM.46.E [Figure 2.2], for which the basic function is renewable energy generation. Therefore, the implementation of projects consisting in the construction of offshore wind farms in these areas is in accordance with the applicable spatial development plan.

As part of the planning process, the delimitation of the E areas was carried out in line with specific planning principles, according to which the areas with the function of "renewable energy generation":

- should satisfy technical criteria (wind, depth, distance from shore);
- must not be designated within the territorial sea;
- must comply with the applicable location decisions;

¹ Appendix 1 to the Regulation of the Council of Ministers of 14 April 2021

- must be located at least 2 km from the boundaries of Natura 2000 sites;
- must not be designated within the Polish Navy training area;
- should not be located in areas important for fisheries;
- the development area should be located 2 NM from sea areas with the Transport (T) function.

Some of the conditions have been incorporated into the Plan, and therefore the General Provisions state that:

- if the area is found to be of high value for avifauna and it becomes necessary to establish a flight corridor for migrating birds, the Plan recommends that the width of such a corridor should not be less than 4 km and that its axis should be a straight line. The exact direction and size of such a corridor should be determined as part of the environmental impact assessment of individual projects – §6.6.2 of the General Provisions;
- any structures and equipment associated with the offshore wind farm, as well as internal connection infrastructure of the offshore wind farm, must not be located closer than 2 nautical miles from the boundary of the areas with the primary function of "transport", with the exception of projects for which valid permits were issued prior to the entry into force of the Regulation – §6.6.3 and 4 of the General Provisions.

In addition to the basic functions, the Plan also allows for other functions in separate sea areas, in accordance with the principle that their implementation cannot disturb the intended use of the sea area in a manner permanently preventing the implementation of the primary function (Art. 37.a.3 of the Act of 21 March 1991 on the maritime areas of the Republic of Poland and maritime administration).

The following functions are allowed within the borders of the sea area POM.46.E:

1. aquaculture (A);
2. scientific research (N);
3. cultural heritage (D);
4. technical infrastructure (I);
5. prospecting and exploration of mineral deposits and extraction of minerals from deposits (K);
6. fisheries (R);
7. artificial islands and structures (W);
8. transport (T);
9. tourism, sport and recreation (S).

In relation to functions allowed, the Plan introduces certain restrictions on their implementation in the sea area POM.46.E, such as:

1. for aquaculture – it is possible only if agreed with the relevant investor of offshore wind farms;
2. prospecting and exploration of mineral deposits and extraction of minerals from deposits – also, a limitation was introduced to the projects agreed with the relevant investor of offshore wind farms; at the same time it was prohibited to construct artificial islands, structures and equipment for hydrocarbon extraction;
3. for transport and fisheries:
 - no restrictions introduced until the commencement of the project;

- upon project commencement, there is a requirement to implement, by a decision of a territorially competent director of the maritime office, a prohibition to conduct fishing and navigation in the sea area occupied by the structure, which also applies to a 500-metre safety zone around the sea area, throughout the duration of the construction works;
- during the operation phase:
 - there is a requirement to implement restrictions on fishing in the safety zones established for each project and it is recommended to develop principles for fishing in the area of offshore wind farms. The principles should be developed by a team coordinated by the minister in charge of fisheries in agreement with the minister in charge of energy, the minister in charge of economy and the minister in charge of maritime economy, such team also to include representatives of the offshore wind energy sector;
 - there is a requirement to establish conditions for safe navigation, by means of a decision of the territorially competent director of the maritime office; until that time, the plan restricts navigation to vessels up to 50 m in length, except for vessels related to the service and maintenance of offshore wind farm structures and equipment;
- regarding aquaculture, prospecting and extraction of mineral deposits, or scientific research, the execution of these functions is restricted to activities that do not interfere with linear elements of technical infrastructure.

The project also introduces certain limitations in relation to permissible functions, which are closely related to the implementation of the priority function, such as linear infrastructure and artificial islands and structures. These are mostly restrictions relating to environmental conditions:

- restriction related to maintaining the welfare of commercially harvested fish. The implementation of these functions is limited to methods which do not endanger the ecological function of spawning grounds and the survival of the early development stages (eggs and larvae) of commercial fish species;
- laying linear elements of the technical infrastructure restricted to infrastructure necessary for the performance of the energy generation function, and
- requirement to lay linear elements of the technical infrastructure in a space-efficient manner, below the surface of the seabed, and if this is not possible for environmental or technological reasons, other permanent safeguards should be applied to allow the safe use of anchored set nets.

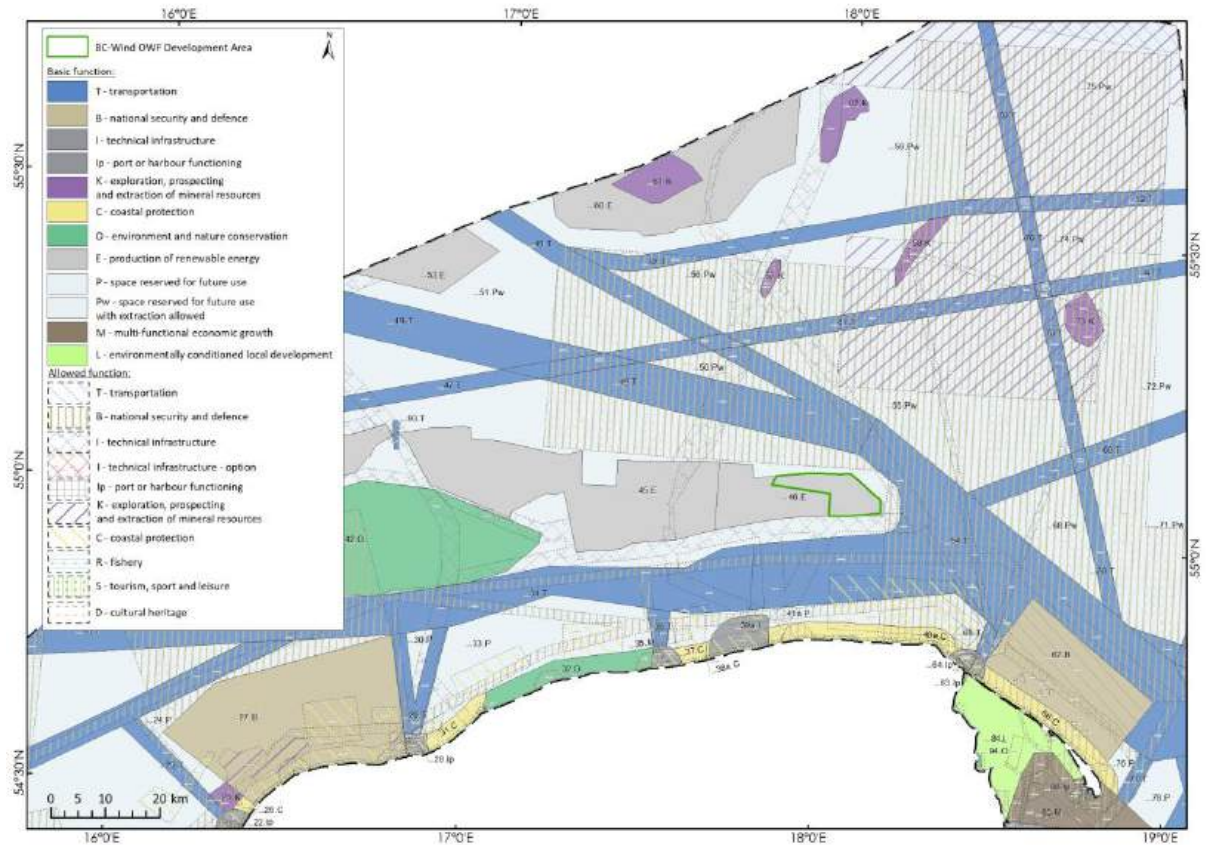


Figure 2.3. The BC-Wind OWF DA against the background of the Maritime Spatial Plan for internal sea waters, territorial sea and the exclusive economic zone [Source: internal materials]

Surroundings of the area analysed, according to the Plan:

- In the immediate vicinity of the area analysed, the following has been designated:
 - from the south, east and north – sea area POM.16.Pw with a primary function of Reserve for future development, with extraction permitted. Within this sea area, a infrastructure sub-area 16.201.I was designated, which is intended, among others, for laying and maintenance of linear elements of technical infrastructure – external connection infrastructure of offshore wind farms. However, in accordance with the General Provisions, the connection infrastructure may be routed outside these sub-areas, if routing in designated sub-areas is impossible due to environmental, technological, economic or national security reasons;
 - from the west – the remaining part of the sea area POM.46.E.
- The nearest sea area with a Transport function, i.e. POM.54.T, is located to the south and east of the area analysed. These were designated taking into account the above-mentioned requirement to maintain a 2 NM buffer between structures and sea areas with a "transport" function. To the north, POM.40.T is designated, constituting a continuation of 54.T – for this sea area, the distance is greater than required.
- No areas with the primary function "state defence and security" were designated in the immediate vicinity; however, sub-area 16.923.B was designated for the Polish Navy training areas (P-15, P-16, P-18, P-19). In line with the provisions of the Plan, changes to their existing development status require an opinion of the Minister of National Defence, and during the

period of activities carried out by the Polish Armed Forces, it may be impossible to carry out other functions in these sub-areas.

- The nearest sub-area designated for the Polish Navy waterway, 56.926.B, is situated to the south of the area.
- In the draft plan, the area 46.E.1 is connected with the sub-area 16.201.I, which is intended, among others, for laying and maintenance of linear elements of technical infrastructure – external connection infrastructure of offshore wind farms.

On the basis of the planning analysis conducted, it should be stated that the BC-Wind OWF implemented in the BC-Wind DA complies with the applicable Maritime Spatial Plan of Polish Sea Areas, at all stages of the project life-cycle.

2.1.4 Stages of 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/7/12 for C-Wind Sp. z o.o. and MFW/4/13 for B-Wind Sp. z o.o. in force;
- optimise economically the entire project;
- enable the comprehensive contracting of the necessary services and supplies;
- consider 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 turbines 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 turbines together with associated infrastructure (e.g. research and measurement infrastructure) designed to deliver the electricity produced to an onshore substation or to monitor the availability of the OWF [Figure 2.4].

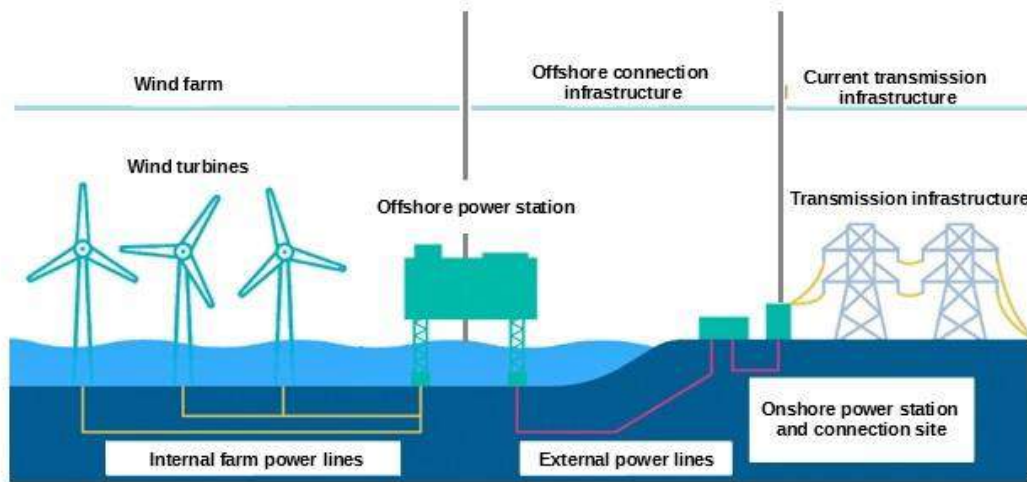


Figure 2.4. Basic elements of the offshore wind farm along with the transmission infrastructure [Source: internal materials]

Wind turbines 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 turbine;
- foundations or support structures;
- connection infrastructure;
- non-productive infrastructure.

Individual components of an OWF are described below.

2.2.2.1 Wind turbine

The wind turbine is an essential component of the wind farm. It comprises three main structural elements, each with a specific function: the tower, the nacelle and the rotor [Figure 2.5].

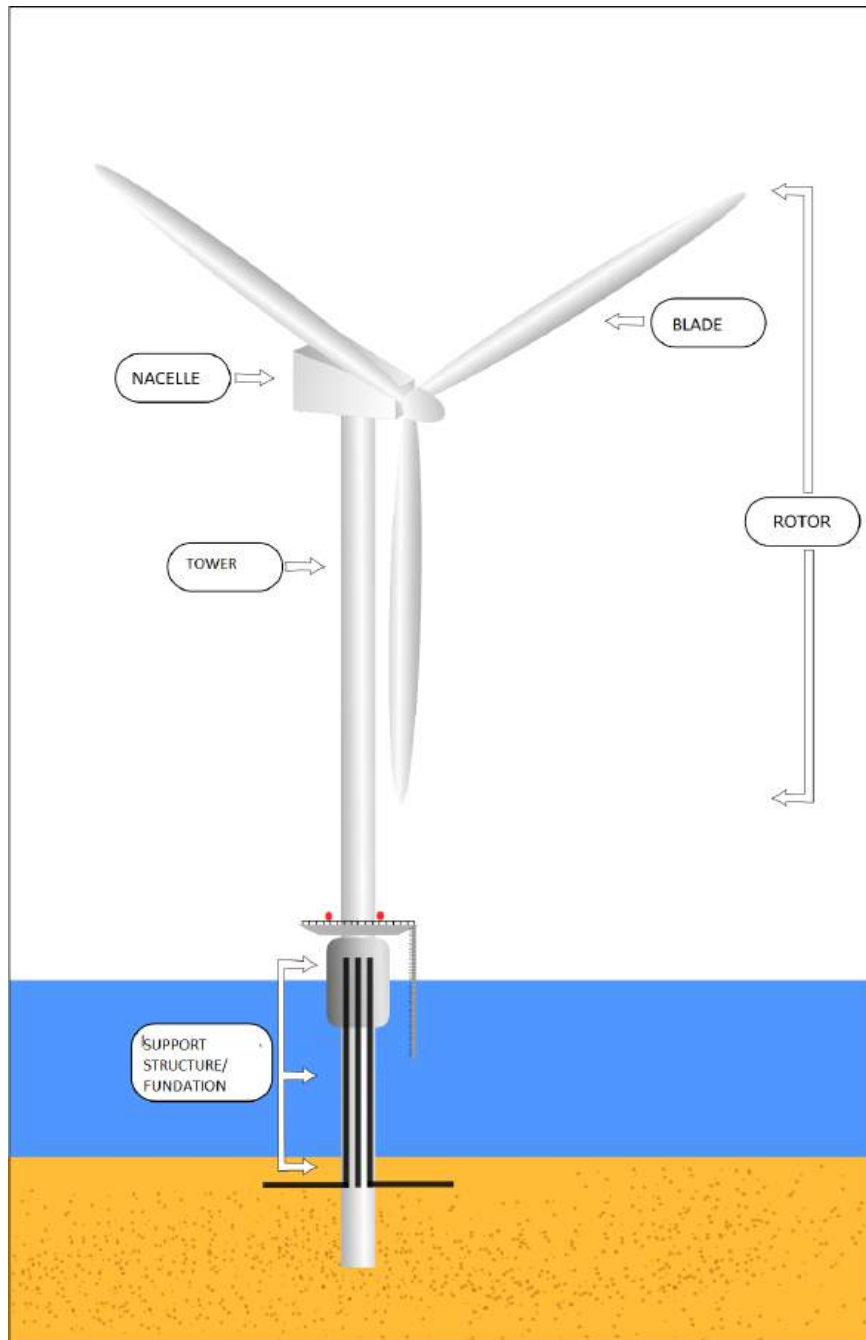


Figure 2.5. Schematic drawing of an offshore wind turbine together with a support structure [Source: internal materials]

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 a wind turbine, the 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 the weight exceeding 100 tonnes [246]. In addition to its basic support function, the tower provides the foundation for laying control cables of the wind turbine, 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 turbine. It consists of drive system devices and a housing protecting it against weather conditions [Figure 2.6]. The drive system ensures the conversion of rotational energy from the rotor to electric 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, 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. This solution is characterised by lower failure rate of the whole system.

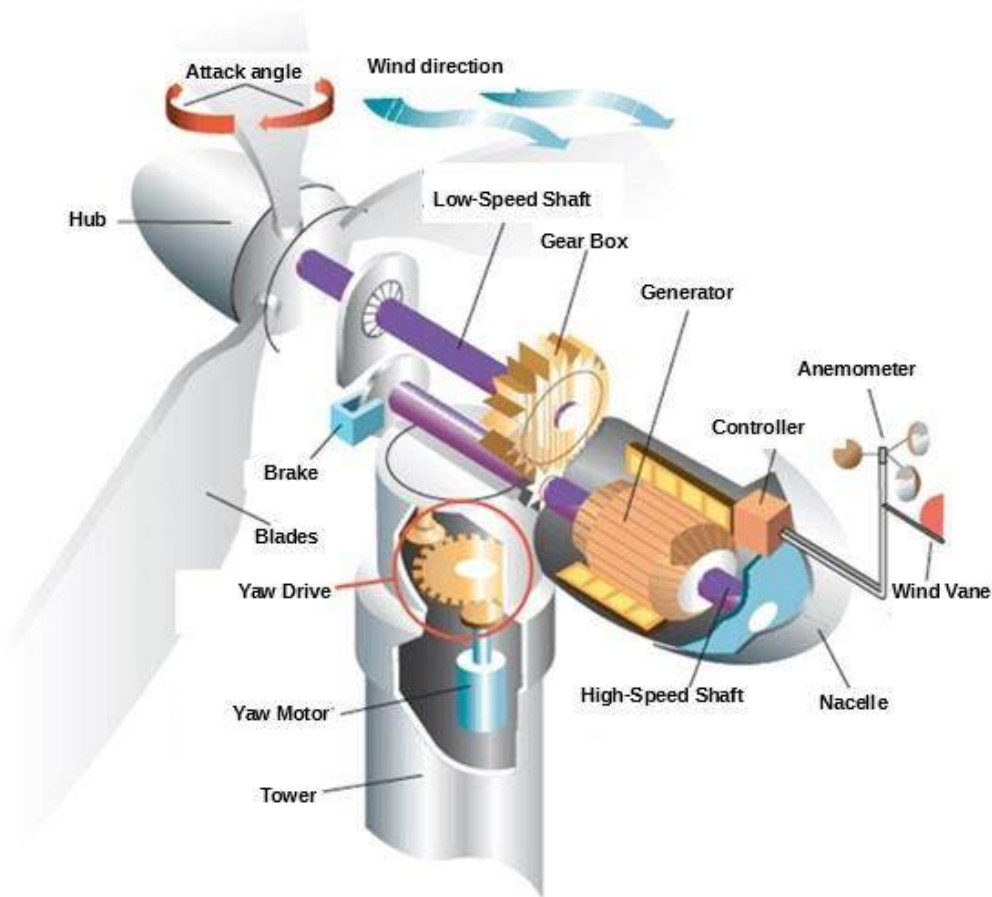


Figure 2.6. Schematic drawing of a nacelle with a gear drive system [Source: Areva]

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 a wind turbine.

The last essential element of a wind turbine 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 Support structures with foundations

The tower of a wind turbine 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 turbine. The support structure or foundation is primarily designed to ensure:

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

Selection of the appropriate type of support structure or foundation depends on the size and weight of the wind turbine 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 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 BC-Wind 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 2.7]. Floating support structures are also possible.

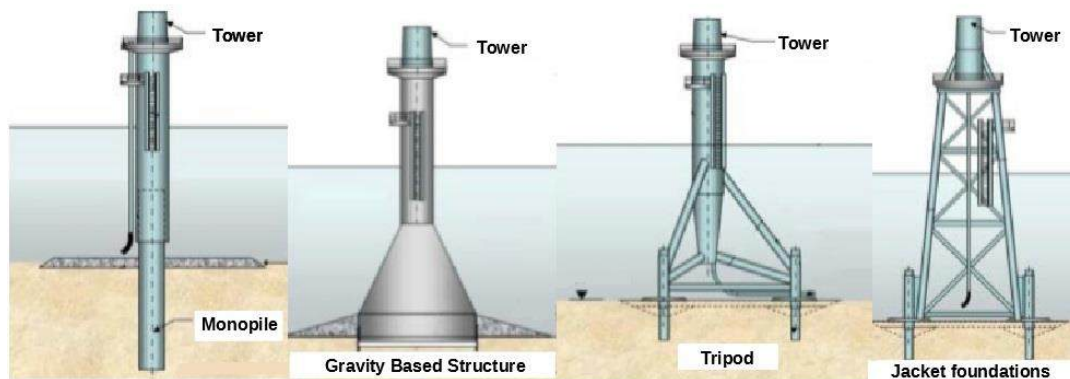


Figure 2.7. Selected types of support structures with fixed-bottom foundations [Source: internal materials, based on: Foundation for Sustainable Energy, Offshore wind energy – an opportunity for the development of maritime industry and coastal regions – conference material, Słupsk 2013 (<https://fnez.pl/biblioteka-fnez/>)]

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 OWF 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 the 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 2.8]:

- 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.

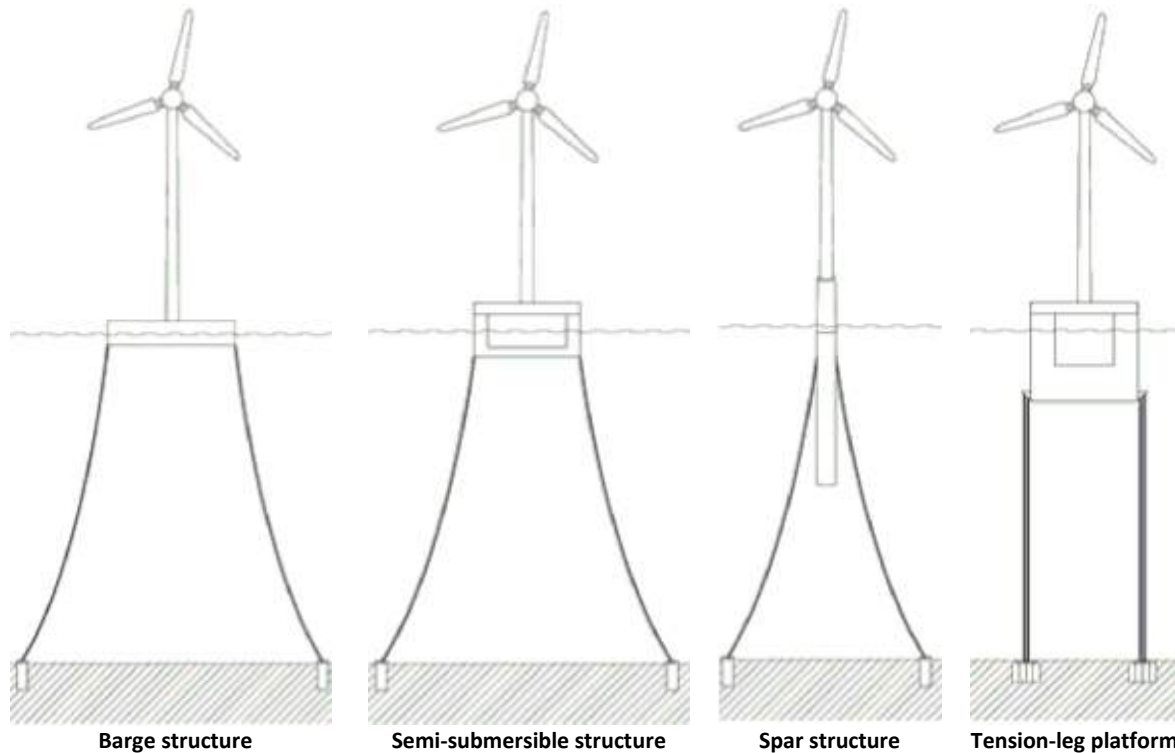


Figure 2.8. Types of floating support structures [Source: internal materials, based on <https://rules.dnvgl.com/docs/pdf/DNVGL/ST/2018-07/DNVGL-ST-0119.pdf>]

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 turbines 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 2.9].



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 2.9. Three-core AC cable [Source: Report on the Environmental Impact Assessment of the Baltic Power Offshore Wind Farm, 2020 [319]]

Given the development of wind turbines with increasing nominal capacity, 66 kV voltage is used more and more often. In the specifications of some power stations, manufacturers of wind turbines directly indicate that 66 kV transformers will be used. This concerns, among others, the MHI Vestas V164-10.0 wind turbine (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 2.10], are designed to transform and transfer the energy generated by wind turbines 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 adjust the voltage of current from wind turbines (usually 33/66 kV) to a transmission voltage required (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 2.10. 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 turbines. 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 concern mainly the electrical system.

2.2.2.4 Non-productive infrastructure

As part of the BC-Wind OWF implementation, it is possible to build (optionally) four platforms not directly related to power generation:

- research and measurement 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 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 the 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:

- maximum total installed capacity of the OWF – the final capacity will be derived from optimisation from the point of view of environmental, technological and economic conditions or other factors;
- the maximum total number of wind turbines – a parameter resulting from the maximum installed capacity of the OWF and the assumed size of wind turbines; it is possible to use wind turbines of different size and power within the OWF;
- the maximum diameter of the rotor of a wind turbine – 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 turbine structure including the rotor – a parameter defining the maximum height of the wind turbine 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 turbines with substations.

2.3.2 Variants of the project considered along with the justification for 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 decisions PSzW no. MFW/7/12 and PSzW no. MFW/4/13), 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 the 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 BC-Wind OWF will achieve the maximum total nominal power specified in the PSzW no. MFW/7/12 and PSzW no. MFW/4/13. This variant provides for the possibility of using wind turbines of various capacities, with a single turbine capacity of no less than 12 MW. Moreover, different types of foundations or support structures are allowed. The implementation of the BC-Wind OWF project with a total maximum capacity (up to 500 MW) assumes the installation of up to 41 wind turbines.

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 turbines 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 12 MW under this variant, any other feasible solution (with higher turbine capacity) will result in the following:

- fewer wind turbines;
- 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 8 MW. The assumed wind turbine capacity, with a maximum total nominal OWF capacity (500 MW), determines the number of wind turbines, which is 62 for this variant.

Similarly to the APV, it is assumed, in the RAV, that different types of wind turbines 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 2.3] presents the most important parameters of the project for both variants analysed in this EIA Report.

Table 2.3. Compilation of key parameters of the BC-Wind OWF for the Applicant Proposed Variant (APV) and the Rational Alternative Variant (RAV) [Source: internal materials]

Parameter	Unit	APV	RAV
Maximum installed capacity	MW	500	500
Maximum number of wind turbines	-	41	62
Maximum diameter of the rotor	m	280	180
Minimum clearance between the rotor operation area and the water surface	m	20	20
Maximum height	MASL	330	250
Maximum number of additional structures	-	6	6
Maximum length of inner cable routes in the OWF	km	188	188

2.4 Description of individual 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 a manner typical of maritime operations, accounting for 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 turbines) 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 turbines or accompanying platforms and enabling a safe transfer of people and smaller equipment to structural elements of OWFs.

In certain cases, especially during the OWF operation 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 the 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 BC-Wind OWF project, such ports of installation are considered as 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 operation phase of the BC-Wind 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, Darłówko as well as Kołobrzeg or Dziwnów.

Pursuant to 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 director of the maritime office managing the given area will be able to establish, by way of 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 BC-Wind OWF implementation, mandatory legal requirements and good practices will be applied regarding waste and sewage treatment. During various phases of the BC-Wind OWF implementation, various hazardous materials will be used. A relevant list and estimated quantities assumed are presented in tables [Table 2.4–Table 2.6], 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 BC-Wind 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 ppm 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 projects 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 turbines, 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 turbines, 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 3 years – up to 5 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 turbine components will be performed and where OWF construction elements will be stored. The area will be located in the port or shipyard infrastructure existing for the duration of the project, with 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 BC-Wind 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 the sediments displaced will be fully managed within the BC-Wind OWF Area. The sediment will be handled only in the closest vicinity of the work. No pollution has been found within the sediments in the BC-Wind OWF Area, therefore it is not planned to be transferred to offshore dump site or landfills. The highest volume 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 [68, 352]. 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 [69] [Figure 2.11].

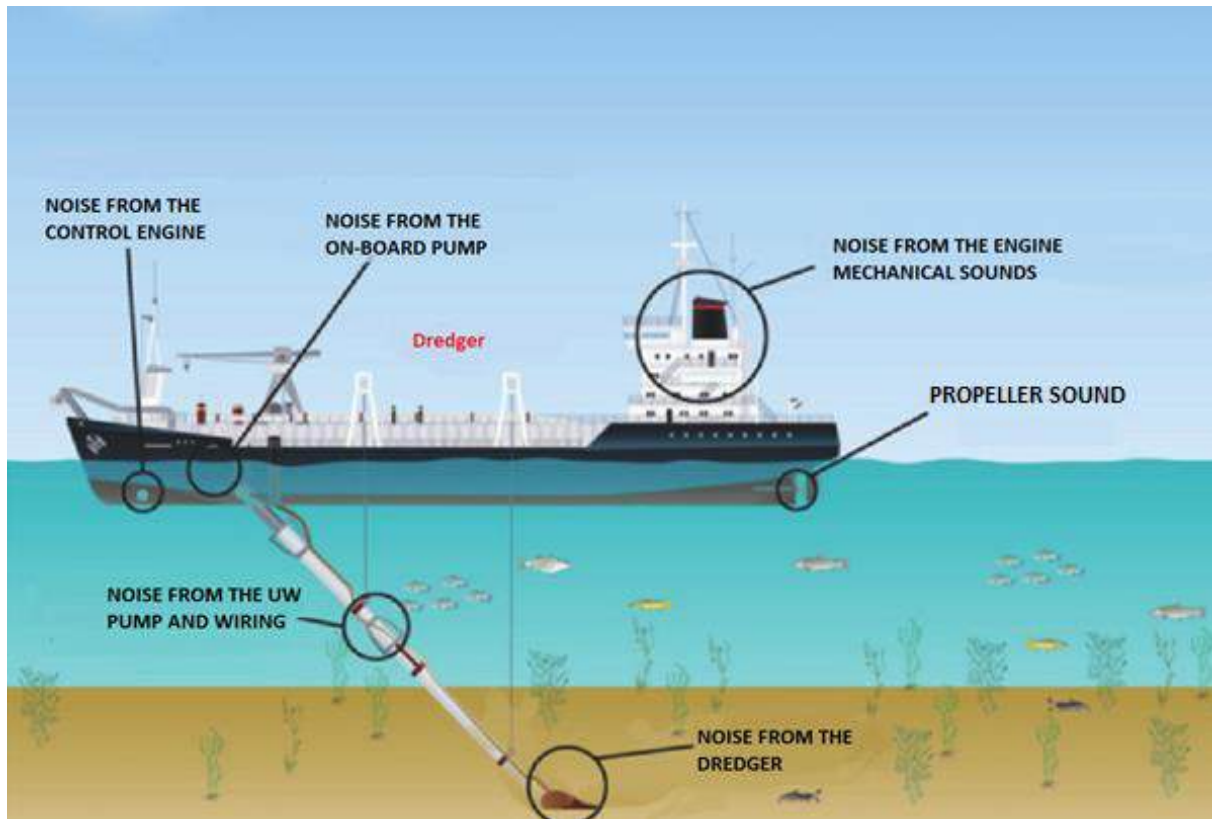


Figure 2.11. Schematic illustration of the TSHD dredger operation [Source: CEDA, 2011 [69]]

Robinson *et al.* [370] 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 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 μ Pa rms at 1 m [439, 370]. 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 operation 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 be carried out using the 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 BC-Wind 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, 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 BC-Wind OWF divided in accordance with the Regulation of the Minister of the Climate of 2 January 2020 on Waste Catalogue (Journal of Laws of 2020, item 10) are presented in Table 2.4. 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 2.4. Compilation of estimated amounts of waste generated during the construction phase of the BC-Wind OWF, annually [Source: internal materials based on the Baltic II EIA Report [153]]

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-based chlorinated hydraulic oils	0.05
13 01 10*	Mineral based non-chlorinated hydraulic oils	0.05
13 01 11*	Synthetic hydraulic oils	0.05
13 02 04*	Mineral-based chlorinated engine, gear and lubricating oils	0.05
13 02 05*	Mineral-based non-chlorinated engine, gear and lubricating oils	0.05
13 02 06*	Synthetic engine, gear and lubricating oils	0.05
13 02 07*	Readily biodegradable engine, gear and lubricating oils	0.05
13 02 08*	Other engine, gear and lubricating oils	0.05
13 03 01*	Insulating or heat transmission oils containing PCBs	0.20
13 04 03*	Bilge oils from sea vessels	0.10
13 05 02*	Sludges from oil/water separators	0.50
13 05 06*	Oil from oil/water separators	0.50
13 05 07*	Oily water from oil/water separators	0.50
13 07 01*	Fuel oil and diesel	0.05
13 07 02*	Petrol	0.05
13 08 80	Oily solid waste from ships	0.10
14 06 01*	Chlorofluorocarbons, HCFC, HFC	0.05
14 06 02*	Other halogenated 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
15 01 03	Wooden packaging	2.00
15 01 04	Metal packaging	2.00

Waste code (*hazardous waste)	Waste type	Estimated quantity [Mg/year]
15 01 05	Composite 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. PCBs)	1.00
15 02 03*	Absorbents, filter materials, wiping cloths (e.g. rags, wipes) and protective clothing other than those mentioned in 15 02 02	1.00
16 06 01*	Lead batteries	0.10
16 06 02*	Ni-Cd batteries	0.10
16 06 03*	Mercury-containing batteries	0.01
16 06 04	Alkaline batteries (except 16 06 03)	0.01
16 06 05	Other batteries and accumulators	0.01
16 81 01*	Wastes exhibiting hazardous properties	1.00
16 81 02	Wastes other than those mentioned in 16 81 01	1.00
17 01 01	Waste concrete and concrete rubble from demolitions and renovations	50.00
17 01 03	Tiles and ceramics	10.00
17 01 82	Wastes not otherwise specified	50.00
17 02 01	Wood	2.00
17 02 02	Glass	0.10
17 02 03	Plastic	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	Mixed metals	0.05
17 04 11	Cables other than those mentioned in 17 04 10	5.00
17 09 03*	Other construction and demolition wastes (including mixed wastes) containing hazardous substances	20.00
17 09 04	Mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03	20.00
19 08 05	Sludges from treatment of urban waste water	1.00
20 01 01	Paper and cardboard	1.00
20 01 02	Glass	1.00
20 01 08	Biodegradable kitchen and canteen waste	1.00
20 01 10	Clothes	1.00
20 01 21*	Fluorescent tubes and other mercury-containing waste	0.05
20 01 23*	Discarded equipment containing chlorofluorocarbons	0.05
20 01 29*	Detergents containing hazardous substances	0.05
20 01 30	Detergents other than those mentioned in 20 01 29	0.05

Waste code (*hazardous waste)	Waste type	Estimated quantity [Mg/year]
20 01 33*	Batteries and accumulators included 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 mentioned in 20 01 33	0.05
20 01 35*	Discarded electrical and electronic equipment other than those mentioned in 20 01 21 and 20 01 23 containing hazardous components (1)	0.05
20 01 36	Discarded electrical and electronic equipment other than those mentioned in 20 01 21, 20 01 23 and 20 01 35	0.05
20 03 01	Mixed municipal waste	20.00

2.4.3 Construction and operation phase

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

2.4.4 Operation phase

Unlike the construction phase, this phase will be characterised by reduced vessel traffic. Regarding the general vessel traffic, an increased proportion of small and medium-sized vessel traffic related to the OWF operation and maintenance will be recorded for this phase. 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 turbines. 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 specialist offshore operations related to the operation phase of the BC-Wind OWF will be proportional to the number of facilities installed and constructed in the OWF Area, also including 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 operation will be a long-term project. Offshore wind turbines will be connected with the offshore substations by power grids and telecommunication networks. It is assumed that the total length of cable routes along which the cables will be laid in the OWF Area will not exceed 188 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 [324]. 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 [357]. 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 [284]. According to the Guidelines on Best Environmental Practice (BEP) in Cable Laying and Operation, prepared by the OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic [324], the burial of the cable at a depth of 1 to 3 m below the seabed is sufficient to ensure that 0.2 m below the surface of the seabed the rise in sediment temperature due to heat emission from the power cables under load is not greater than 2°C. The minimum burial depth should be determined on the basis of the type of sediments (their thermal conductivity) and the type of power grid (size and type of loads, thermal properties).

Waste

The expected types and quantities of waste generated during the operation phase of the BC-Wind OWF divided in accordance with the Regulation of the Minister of the Climate of 2 January 2020 on Waste Catalogue (Journal of Laws of 2020, item 10) are presented in Table 2.5. The amounts of waste shown refer to a single offshore wind turbine 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 BC-Wind OWF operation stage is the operation of ships and performance of repairs.

Table 2.5. Compilation of waste generated during the operation phase of the BC-Wind OWF, annually [Source: internal materials based on the Baltic II EIA Report [153]]

Waste code (*hazardous waste)	Waste type	Estimated quantity [Mg/year]
08 01 11*	Waste paint and varnish containing organic solvents or other hazardous substances	0.21
08 01 12	Waste paints and varnishes other than those listed in 08 01 11	0.21
12 01 13	Welding waste	0.04
13 01 09*	Mineral-based chlorinated hydraulic oils	0.01
13 01 10*	Mineral based non-chlorinated hydraulic oils	0.01
13 01 11*	Synthetic hydraulic oils	0.01
13 01 12*	Readily biodegradable hydraulic oils	0.01
13 01 13*	Other hydraulic oils	0.01
13 02 04*	Mineral-based chlorinated engine, gear and lubricating oils	0.01
13 02 05*	Mineral-based non-chlorinated engine, gear and lubricating oils	0.01
13 02 06*	Synthetic engine, gear and lubricating oils	0.01
13 02 07*	Readily biodegradable engine, gear and lubricating oils	0.01
13 02 08*	Other engine, gear and lubricating oils	0.01
13 03 01*	Insulating or heat transmission oils containing PCBs	0.42
13 04 03*	Bilge oils from sea vessels	0.04
13 05 02*	Sludges from oil/water separators	0.21
13 05 06*	Oil from oil/water separators	0.21
13 05 07*	Oily water from oil/water separators	0.21
13 07 01*	Fuel oil and diesel	0.04
13 07 02*	Petrol	0.02
13 08 80	Oily solid waste from ships	0.04
14 06 01*	Chlorofluorocarbons, HCFC, HFC	0.02
14 06 02*	Other halogenated solvents and solvent mixtures	0.02
14 06 03*	Other solvents and solvent mixtures	0.02
15 01 01	Paper and cardboard packaging	0.04
15 01 02	Plastic packaging	0.04
15 01 03	Wooden packaging	0.04
15 01 04	Metal packaging	0.04
15 01 05	Composite packaging	0.04
15 01 06	Mixed packaging waste	0.04
15 01 07	Glass packaging	0.04
15 01 09	Textile packaging	0.04
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. PCBs)	0.12
15 02 03*	Absorbents, filter materials, wiping cloths (e.g. rags, wipes) and protective clothing other than those mentioned in 15 02 02	0.12
16 06 01*	Lead batteries	0.04

Waste code (*hazardous waste)	Waste type	Estimated quantity [Mg/year]
16 06 02*	Ni-Cd batteries	0.04
16 06 03*	Mercury-containing batteries	0.04
16 06 04	Alkaline batteries (except 16 06 03)	0.04
16 06 05	Other batteries and accumulators	0.01
16 81 01*	Wastes exhibiting hazardous properties	0.12
16 81 02	Wastes other than those mentioned in 16 81 01	0.12
17 01 01	Waste concrete and concrete rubble from demolitions and renovations	2.10
17 01 03	Tiles and ceramics	0.41
17 01 82	Wastes not otherwise specified	2.10
17 02 01	Wood	0.08
17 02 02	Glass	0.04
17 02 03	Plastic	0.21
17 04 01	Copper, bronze, brass	0.02
17 04 02	Aluminium	0.02
17 04 04	Zinc	0.02
17 04 05	Iron and steel	0.41
17 04 07	Mixed metals	0.02
17 04 11	Cables other than those mentioned in 17 04 10	2.10
17 09 03*	Other construction and demolition wastes (including mixed wastes) containing hazardous substances	0.82
17 09 04	Mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03	0.82
19 08 05	Sludges from treatment of urban waste water	1.230
20 01 01	Paper and cardboard	0.82
20 01 02	Glass	0.82
20 01 08	Biodegradable kitchen and canteen waste	0.82
20 01 10	Clothes	0.82
20 01 21*	Fluorescent tubes and other mercury-containing waste	0.04
20 01 23*	Discarded equipment containing chlorofluorocarbons	0.04
20 01 29*	Detergents containing hazardous substances	0.04
20 01 30	Detergents other than those mentioned in 20 01 29	0.04
20 01 33*	Batteries and accumulators included in 16 06 01, 16 06 02 or 16 06 03 and unsorted batteries and accumulators containing these batteries	0.04
20 01 34	Batteries and accumulators other than those mentioned in 20 01 33	0.04
20 01 35*	Discarded electrical and electronic equipment other than those mentioned in 20 01 21 and 20 01 23 containing hazardous components (1)	0.04
20 01 36	Discarded electrical and electronic equipment other than those mentioned in 20 01 21, 20 01 23 and 20 01 35	0.04
20 03 01	Mixed municipal waste	12.30

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 BC-Wind 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, 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.

It is expected that decommissioning of the structures in the BC-Wind 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 BC-Wind OWF, the generation of waste is mainly related to the physical removal of the worn-out components of the BC-Wind OWF, and the operation of ships used during the decommissioning.

Waste

The types and quantities of waste expected to be generated during the decommissioning phase of the BC-Wind OWF divided in accordance with the Regulation of the Minister of the Climate of 2 January 2020 on Waste Catalogue (Journal of Laws of 2020, item 10) are presented in Table 2.6. The amounts of waste presented concern a single OWF or an offshore substation or 1 km of a 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 BC-Wind 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 BC-Wind OWF, the generation of waste is mainly related to the physical removal of the worn-out components of the BC-Wind OWF, and the operation of ships used during the decommissioning.

Table 2.6. Compilation of waste generated during the decommissioning phase of the BC-Wind OWF, for a single structure [Source: internal materials based on the Baltic II EIA Report [153]]

Waste code (*hazardous waste)	Waste type	Estimated quantity [Mg/structure]
13 01 09*	Mineral-based chlorinated hydraulic oils	0.05
13 01 10*	Mineral based non-chlorinated hydraulic oils	0.05
13 01 11*	Synthetic hydraulic oils	0.05
13 01 12*	Readily biodegradable hydraulic oils	0.05
13 01 13*	Other hydraulic oils	0.05
13 02 05*	Mineral-based non-chlorinated engine, gear and lubricating oils	0.01
13 02 05*	Mineral-based non-chlorinated engine, gear and lubricating oils	0.01
13 02 06*	Synthetic engine, gear and lubricating oils	0.01

Waste code (*hazardous waste)	Waste type	Estimated quantity [Mg/structure]
13 02 07*	Readily biodegradable engine, gear and lubricating oils	0.01
13 02 08*	Other engine, gear and lubricating oils	0.01
13 03 01*	Insulating or heat transmission oils containing PCBs	82.5
13 04 03*	Bilge oils from sea vessels	0.1
13 07 01*	Fuel oil and diesel	0.05
13 07 02*	Petrol	0.05
13 08 80	Oily solid waste from ships	0.1
14 06 01*	Chlorofluorocarbons, HCFC, HFC	0.1
14 06 02*	Other halogenated 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	Composite packaging	0.1
15 01 06	Mixed packaging waste	0.1
15 01 07	Glass packaging	0.1
15 01 09	Textile packaging	0.1
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
15 02 03*	Absorbents, filter materials, wiping cloths (e.g. rags, wipes) and protective clothing other than those mentioned in 15 02 02	1
16 06 01*	Lead batteries	0.1
16 06 02*	Ni-Cd batteries	0.1
16 06 03*	Mercury-containing batteries	0.01
16 06 04	Alkaline batteries (except 16 06 03)	0.01
16 06 05	Other batteries and accumulators	0.01
16 81 01*	Wastes exhibiting hazardous properties	1
16 81 02	Wastes other than those mentioned in 16 81 01	1
17 01 01	Waste concrete and concrete rubble from demolitions and renovations	7000
17 01 03	Tiles and ceramics	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	Wastes not otherwise specified	50
17 02 01	Wood	0.1
17 02 02	Glass	2
17 02 03	Plastic	1000
17 04 01	Copper, bronze, brass	1
17 04 02	Aluminium	1
17 04 04	Zinc	1

Waste code (*hazardous waste)	Waste type	Estimated quantity [Mg/structure]
17 04 05	Iron and steel	4000
17 04 07	Mixed metals	1
17 04 11	Cables other than those mentioned in 17 04 10	71
17 09 03*	Other construction and demolition wastes (including mixed wastes) containing hazardous 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	Sludges from treatment of urban waste water	1
20 01 01	Paper and cardboard	1
20 01 02	Glass	1
20 01 08	Biodegradable kitchen and canteen waste	1
20 01 10	Clothes	1
20 01 21*	Fluorescent tubes and other mercury-containing waste	0.05
20 01 23*	Discarded equipment containing chlorofluorocarbons	0.05
20 01 29*	Detergents containing hazardous substances	0.05
20 01 30	Detergents other than those mentioned in 20 01 29	0.05
20 01 33*	Batteries and accumulators included 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 mentioned in 20 01 33	0.05
20 01 35*	Discarded electrical and electronic equipment other than those mentioned in 20 01 21 and 20 01 23 containing hazardous components (1)	0.05
20 01 36	Discarded electrical and electronic equipment other than those mentioned in 20 01 21, 20 01 23 and 20 01 35	0.05
20 03 01	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 turbines 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 are presented in Table 2.7.

Table 2.7. Average fuel consumption for different types of vessels [Source: internal materials based on Borkowski [45]]

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, operation and decommissioning phase of the BC-Wind OWF is proportional to the number of facilities installed and constructed in the OWF Area, also including the length of the installed electricity grid. Therefore, fuel quantities and transport related emissions will be lower for APV than for RAV.

2.5 Risk of major accidents or natural and construction disasters

2.5.1 Types of accidents resulting in environmental contamination

The project related to the OWF construction, operation and decommissioning is a project 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 operation takes place on land. Construction, installation, service, renovation and subsequent demolition work are carried out at sea. All these activities depend on vessels intended for transportation, service and construction.

Ports and ships are of key importance during the implementation of the project. Large-scale components of wind turbines, foundations or structures and towers, accommodation and service platforms and research and measurement 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 turbines, 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 extent of oil pollution can be classified as follows:

- **I degree (small spill, up to 20 m³)** – small spills of petroleum products that do not require the intervention of external forces and resources and are possible to be removed with own resources. These spills are of local character, their removal does not pose particular technical difficulties and they do not pose a significant threat to the marine environment;
- **II degree (medium-sized spill, up to 50 m³)** – spills of petroleum products, 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 spill, above 50 m³)** – spills of petroleum products that are 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 an assessment of potential impacts

2.5.2.1 Spill of petroleum products (during normal operation of vessels)

Various petroleum products (lubricating and diesel oils, petrol) may spill 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 spills are: the Słupsk Bank and the coastal area approximately between 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 potential pollution are the conservation areas including the areas belonging to NATURA 2000 network of nature protection areas.

It should be emphasised that the key issue here is not so much the size of the spill 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 loss in populations as smaller spills in areas of high concentration of seabirds [280]. In the planned BC-Wind 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 project implementation, its operation or decommissioning.

Spillage of petroleum products (during an emergency situation)

During the construction, operation and decommissioning phase of the BC-Wind OWF a spillage of oil derivative substances may occur, 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 the OWF structures, the vessel sinking or grounding, as well as during seepage and operational leaks from vessels, leakage from oil systems of a wind turbines, 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 case in 100 000 years) to 10^{-3} (very rare – 1 case in 1000 years).

Assuming the worst-case scenario and the release of 200 m³ of diesel fuel into the marine environment, as well as taking into account its type, the behaviour in seawater, the time of the oil dispersion and drift, it is estimated that the extent of pollution will not exceed 5 to 20 km from the BC-Wind OWF. 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 OWF construction, 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 at the project site. 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 m³. It has been assumed that during transshipment about 5 m³ of the product can sink. Grout, mortar and other sealants often contain hazardous substances. For example, (two-component) epoxy binders contain various proportions of: epoxy resin, alkylglycidyl ethers and polyaminoamides. Due to their high density (ca. 1.3 g·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. Releases during handling can be prevented by following appropriate work procedures.

2.5.3 Other types of releases

2.5.3.1 Release of municipal waste or domestic sewage

During the OWF construction, aboard vessels and in the infrastructure situated on land (in the port supporting the implementation of the project) 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 the 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

Hulls of vessels are protected against fouling with biocides, which may contain e.g. copper, mercury and organotin compounds (e.g. TBT). These substances can transfer into water and eventually be retained in the sediments. It should be assumed that emissions of these compounds will be

insignificant. Among the substances listed, organotin compounds are the most harmful (toxic) to aquatic organisms. Currently, the usage of TBT in antifouling paints is prohibited [289]. 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 man-made objects lying on the seabed. During geophysical surveys, in 2020, the BC-Wind 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 BC-Wind Area. No such objects were found on the seabed in the BC-Wind Area. However, it is not excluded that such objects may be buried in the seabed, and therefore, were not detected during the geophysical survey. During the geophysical surveys, magnetometric review surveys were carried out, which were to reveal only larger ferromagnetic objects. As a result of the surveys, a torpedo was identified in the BC-Wind Development Area. 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 projects 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, were identified for the construction phase:

- spill of petroleum products as a result of collision of ships, 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 depth 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 the resulting release of dangerous substances into the environment (especially petroleum products) is a factor that can cause increased mortality and diseases of marine organisms. The likelihood of such events can be considered as low. 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 petroleum products) into the environment as a result of collisions of ships. 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 Operation phase

During the operation of the OWF, threats to the environment may occur, especially the contamination of the water depth and seabed sediments by:

- petroleum products;
- 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 the resulting release of dangerous substances into the environment (especially petroleum products) is a factor that 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 operation 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 operation, 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. 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 operation, harmful chemical substances may leak into the environment as a result of collisions and breakdowns of vessels involved in the project service, i.e. 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 risk related to this factor can be considered as negligible.

The main threat to the Natura 2000 sites during the operation phase is the release of hazardous substances (especially petroleum products) into the environment as a result of the collisions of ships.

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 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 operation phase

The collision of ships and the resulting release of dangerous substances into the environment (especially petroleum products) is a factor that 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 operation 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.

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;
- petroleum products;
- 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 above-described impacts occurring in the OWF construction phase.

During the OWF decommissioning, as a result of collisions and breakdowns of vessels 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 risk related to this factor can be considered as negligible.

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, operation and decommissioning of the OWF. These activities include, among others:

- developing plans for the safe construction, operation 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, operation 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, operation and decommissioning of the OWF;
- establishment of a coordination centre supervising the construction, operation 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 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, 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, operation 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

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 the limit value for safe wind turbine operation. The service plan is intended to ensure flawless operation.

The greatest potential risks occur during the construction phase; however, the risk of a 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 (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 accidents and natural or 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 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 remain in the category of very rare events (1 per 200 years). Taking into account the effects in the form of 200 m³ of diesel oil emission, the risk level is within an acceptable range. Emission of 200 m³ of diesel oil will cause insignificant damage to the environment because it will disperse within 12 hours.

2.6 List of measures for preventing unplanned events and reducing their effects

The assumptions of measures for preventing unplanned events resulting from the implementation of the BC-Wind OWF and reducing their effects on the safety of the natural environment and humans are indicated in Table 2.8.

Table 2.8. Measures for preventing unplanned events resulting from the implementation of the BC-Wind OWF and reducing their effects on the safety of the natural environment and humans [Source: internal materials]

Event	Preventive measures
Potential collisions with the vessels navigating along the shipping routes within the area as well as the vessels taking part in the construction of the neighbouring wind farms	During the construction and operation of the BC-Wind OWF, all possible countermeasures shall be applied with the aim to minimise the risk of collision with vessels, in accordance with the applicable regulations and best practices used for this type of offshore projects. Such measures include coordination of vessels operating in vicinity and within the area of an offshore wind farm by implementing a MCP (Marine Coordination Plan), their remote monitoring, marking of the offshore wind farm area at every step of its implementation using navigation buoys, use of surveillance vessel (guard vessels) capable of intercepting other ships. Moreover, the Applicant shall be in constant contact with competent people responsible for the safety of navigation within the areas of other offshore wind farm projects to ensure coordination and harmonisation of operations resulting from shipping activity
Oil spills	In case of emergency, the result of which are oil spills, appropriate measures will be taken to prevent the spread of such substances and they will be removed from the environment. The impact assessment of this kind of events was described in the EIA Report in subsections 2.5.1 and 6.1.2.3. Moreover, it should be indicated that all vessels taking part in the operations connected to the BC-Wind OWF) are subject to all provisions of the International Convention for the Prevention of Pollution from Ships (MARPOL)

Event	Preventive measures
Collisions with the linear infrastructure on the seabed (pipelines, cables)	There are no pipelines nor subsea cables within the area of the planned project and in its immediate vicinity; therefore, there is no danger of collision with this type of infrastructure
Encountering UXOs or CWAs due to interference with the seabed	In case UXOs or CWAs are encountered, measures will be undertaken appropriately to the specific situation, including notification of appropriate authorities and services, and in agreement with them, the Applicant will undertake further actions to eliminate the risk
Potential explosions generated by adjacent industrial and military facilities	No industrial and military facilities are present in the vicinity of the BC-Wind OWF area
Events connected to climate changes and extreme weather phenomena	The scale and nature of the climate changes as well as extreme weather phenomena that may occur in the region of the planned project is difficult, if not impossible to foresee. However, due to the nature of the planned project, this hazard is most probably minor. Moreover, at the designing stage of the BC-Wind OEF construction elements, aspects connected to the potential increase of the sea level, ice phenomena and extreme winds, will be taken into consideration

2.7 Relations between the parameters of the project and its impacts

The matrix of connections between the project parameters and impacts is presented in 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	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 pollutions	Increased traffic and collision risk
Number of wind turbines	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			
Piling parameters						X										
Full height of structure	X				X			X								X
Rotor diameter [m]	X															

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 pollutions	Increased traffic and collision risk
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, time)					X	X	X	X						X	X	X

3 Environmental conditions

3.1 Location, seabed topography

The BC-Wind Area is situated east of the Słupsk Bank and approx. 22.6 km north of the town of Dębki. The BC-Wind Area (1 NM) covers a seabed section with a depth from 27.7 to 65.3 m, the area within the boundaries of the PSzW permits no. MFW/7/12 and MFW/4/13 cover a seabed section with a depth from 31.0 to 61.6 m, while, the Development Area covers a seabed section with a depth from 30.0 to 62.2 m. The depth increases in the north-eastern direction [Figure 3.1].

Based on the analysis of bathymetric data, the seabed relief was identified. The analysis of sonar data enabled the interpretation of seabed features. On this basis, using the data from the surface sample analyses and taking into consideration the general knowledge on the BC-Wind Area (1 NM) [85, 86, 155, 229, 221, 231, 232, 295, 343, 336, 342, 467, 469, 470] a map of seabed types was developed [Figure 3.2].

Within the BC-Wind Area (1 NM) analysed, three seabed types, different in terms of structure and relief character, were distinguished [Figure 3.2]:

- kame terraces;
- abrasive-accumulative plain;
- accumulation plain.

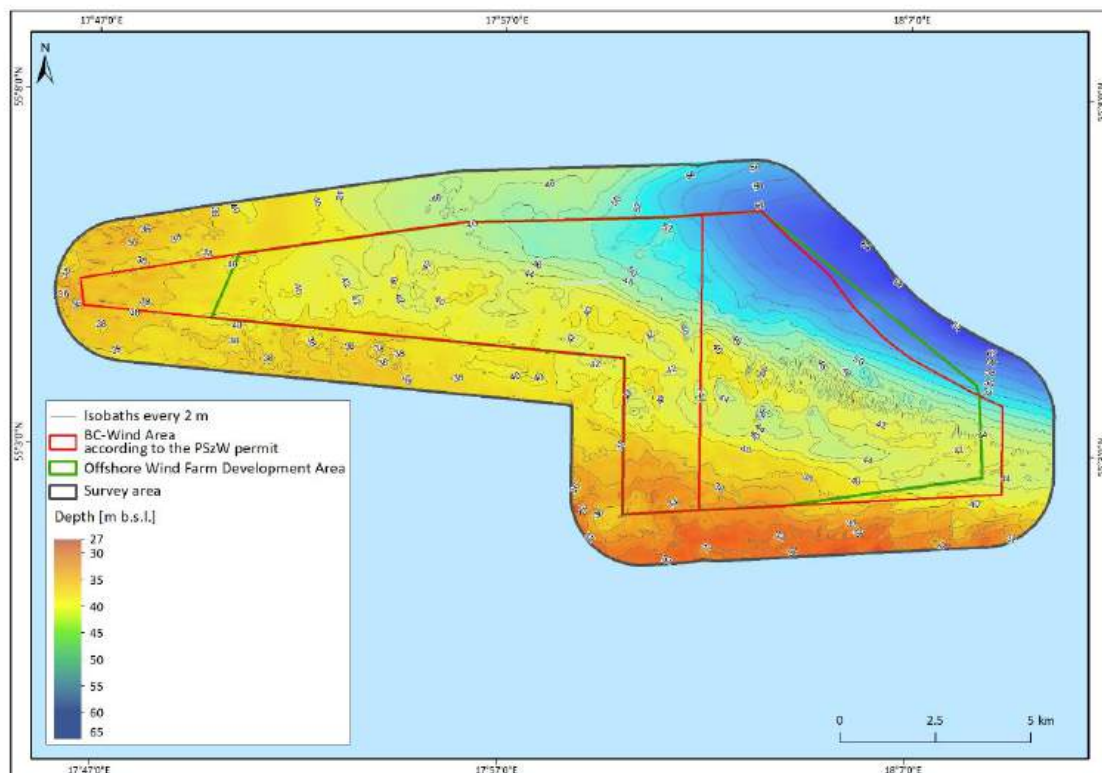


Figure 3.1. Bathymetric map of the BC-Wind Area [Source: internal materials]



Figure 3.2. Map of the BC-Wind Area seabed types [Source: internal materials]

Kame terraces

The seabed area with the most varied relief and structure was identified as the area with a kame terraces character [Figure 3.2]. It covers the western and north-western part of the BC-Wind Area with a depth from 27.6 to 42.0 MBSL. The seabed is diversified with numerous hillocks 2.0–3.0 high (up to 4.0 m at maximum) above the surrounding seabed. These hillocks usually consist of post-glacial sediments. They may be interpreted as the elements of a hillock moraine or forms of a crevasse accumulation, which were formed during the advance of the Vistulian glaciation ice sheet. Seabed slopes are usually up to 2–3°, sometimes over 20° – this applies only to the kame terraces and till outcrops.

Abrasive-accumulative plain

The central part of the BC-Wind Area is occupied by an abrasive-accumulative plain [Figure 3.2]. The plain covers the seabed with a depth from approx. 28.8 to approx. 60.9 MBSL. The seabed is relatively level with small height differences (1–2 m) associated with the presence of sand accumulations on the surface of till and till outcrops. Boulder clusters are present on the seabed. Accumulations of gravel are also visible. Seabed slope within the abrasive-accumulative plain is up to 2–3°.

Accumulation plain

This area of the seabed is characterised by a slightly diversified relief. The area covers the eastern and north-eastern part of the area analysed with a depth from 37.8 up to 64.4 MBSL. The seabed is relatively flat with small, minor height differences reaching up to 2.0 m. In the southern part of the accumulation plain, sandy waves were identified [Figure 3.2]. In the area of sandy waves, the height differences of the seabed reach up to 8 m. The proximal slopes of the waves are directed to the west, and the distal slopes to the east. The ridges of sandy waves have a N–S orientation. The sandy waves

reach up to 2–3 m in height, up to 8 m in places. The length of waves is 40–60 m, 80–100 m in places, and 150 m at maximum.

The seabed slopes of the accumulation plain are about 2°, in some places, over 20° – this applies only to the distal slopes of sand waves.

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

According to the data from literature [85, 155, 229, 221, 231, 232, 295, 343, 469, 470], Quaternary sediments deposited on the Paleogene and Neogene sediments were identified in the seabed structure of BC-Wind Area (1 NM). Below the Paleogene and Neogene layer, the Permian and Triassic sediments were identified. They occur only in the southern and south-eastern part of the survey area. Below the Permian and Triassic sediments, and in the northern and western part of the BC-Wind Area (1 NM), directly below the Paleogene and the Neogene sediments, the Silurian sediments are present.

3.2.1.1 Sub-Quaternary sediments

The oldest structure, identified on the basis of the analysis of seismo-acoustic data, is the top of the sediments classified as Silurian sediments top. It is deposited the deepest in the southern part of the area analysed, at a depth of more than 200 m below the seabed surface; and the shallowest in the north-eastern part of the area, several meters below the seabed. Above the Silurian sediments, in the south-eastern part of the area analysed, sediments interpreted as Permian and Triassic deposits were identified. Their top is uneven, erosive and is deposited at a depth of about 20 to 90 m below the seabed. These sediments have a thickness of 160 m. Above the Permian and Triassic sediments, in the south-eastern part of the area and above the Silurian sediments in the remaining part of the area analysed, Palaeogene and Neogene deposits were identified. Their top is uneven, with numerous height differences. The Palaeogene and Neogene deposits lie at a depth of from a few to 35 MBSB. Their thickness is from 30–40 m to more than 100 m.

3.2.1.2 Quaternary cover

The Quaternary cover forms a continuous layer of glacial, fluvioglacial, glaciolacustrine and modern marine sediments. It forms a layer with a thickness from several to more than 30 m. The surface of the glacial and fluvioglacial sediment top is diversified, however, with no significant height differences. Sediments of this unit were identified within the entire area analysed. These are glacial and fluvioglacial sediments with a predominant share of tills.

In the south-western part of the BC-Wind Area, on the glacial and fluvioglacial sediments, glaciolacustrine deposits were identified, mainly clay, silt and fine sands of the Pleistocene and Holocene. They form a discontinuous layer within the glacial sediment top depressions.

Above the glacial and glaciolacustrine deposits, mainly fine-grained and locally medium-grained sands are deposited. The seabed consists of modern marine sands (the Holocene), and also gravel and silt in places (the Pleistocene/the Holocene). Boulder clusters are present on the surface in places.

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.

In the BC-Wind Area two types of sediments forming the seabed surface were distinguished [Figure 3.3]: the fine- to medium-grained sands, and tills with a stony-gravel abrasive pavement and a sand cover.

The fine-grained and medium-grained sands within the BC-Wind Area form mainly compact covers with flat surfaces (with the exception of those seabed parts on which sandy waves are present). Tills with a stony-gravel abrasive pavement and a sand cover form areas of diverse relief with fields of ripple marks and mega-ripple marks moving over the till surface and abrasive pavement. Locally, the seabed surface consists solely of abrasive pavement on till.

The seabed within the **kame terraces** consists mainly of sand, locally of sand and gravel, as well as tills in the form of outcrops and hillocks often with a stony cover of an erosive pavement character in the till top. Below the sandy and sandy-gravel sediments, the seabed is made of cohesive sediments, mainly till. Till top is uneven, with height differences of up to several meters. The depressions in the till top are filled with a silty-clayey (ice-marginal) material in places, and locally with sand.

The seabed within **the abrasive-accumulative plain** consists of a thin, discontinuous layer of sands with a thickness of up to approx. 0.5 m on a till substratum.

The seabed within **the accumulation platform** consists of a layer of sands with a thickness of up to 1–2 m (locally up to 7–8 m within the area of sandy waves).

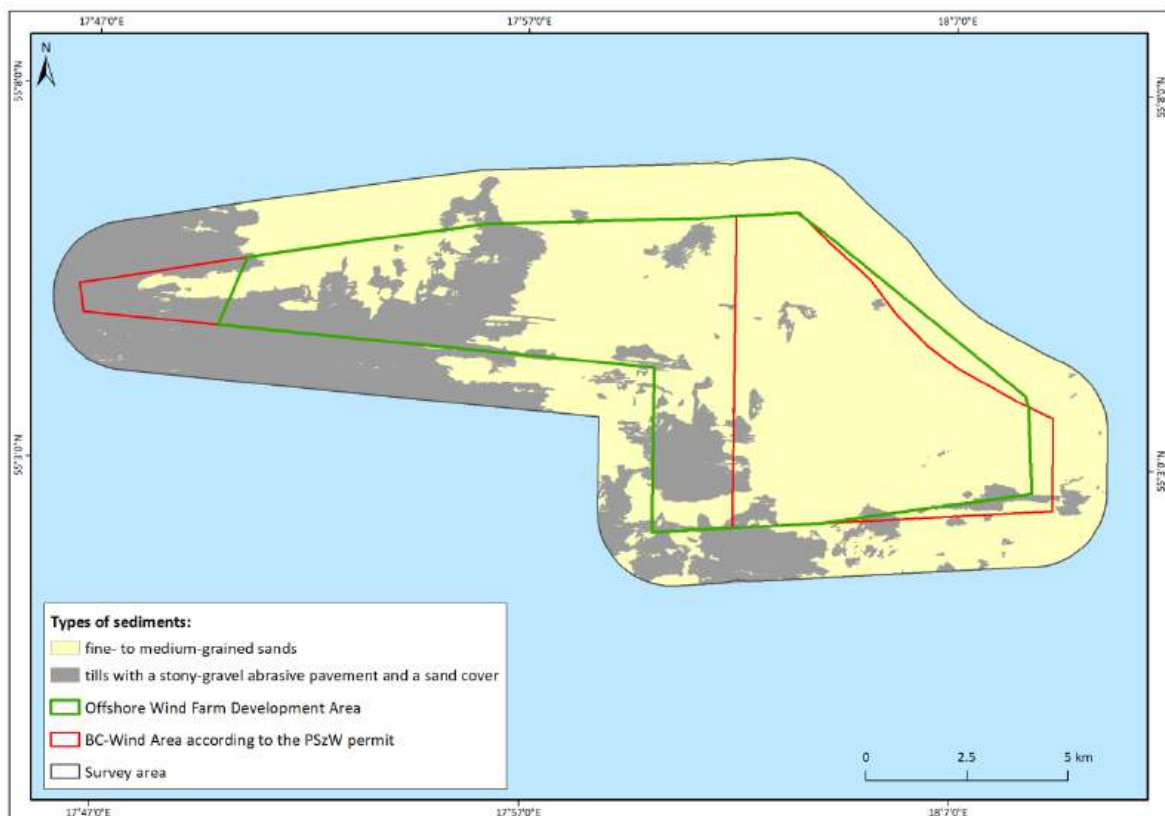


Figure 3.3. Map of surface sediments in the BC-Wind Area [Source: internal materials]

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 operation 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 largest amount of pollutants and nutrients will be transferred to the water from the sediments with an increased organic matter content (e.g. silty, clayey sediments with a higher concentration of metals and POPs). 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 amount of fine fractions and low concentrations of metals and POPs.

The surface seabed sediments from the BC-Wind OWF Area which were analysed belong to inorganic sediments with the organic matter content expressed as loss on ignition (LOI) of less than 4%.

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

None of the sediment samples tested exceeded the limit values specified for the concentration of metals, PAHs and PCBs listed 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 nitrifying bacteria leads to the formation of nitrogen oxides, and later nitrates. Too intensive nitrification, however, is not desirable, as nitrates are more easily eluted from sediments than ammonium ions. The processes related to the construction (laying) of foundations and/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 [312, 460].

In the Baltic Sea sediments, nitrogen occurs mainly in organic form and its regional variability is analogous to the variability of carbon [65]. Usually, inorganic forms of nitrogen constitute no more than 10% of the total nitrogen in the sediments [66]. An increase in the percentage share of inorganic nitrogen forms is possible in the area of erosion and transport of fine particle dispersion sediments [466].

Due to the fact that the circulation of nitrogen in the environment is a very complex process, and its intensity depends on numerous factors (e.g. oxygenation, temperature, season, primary production, etc.) as well as on the volume of nutrient supply from isolated spots, diffused sources and the deposition from the atmosphere [49, 121], a precise calculation of the nitrogen load, which would enter the water column from the sediment during construction works is impossible. For a very general estimation of the load of this element that be transferred to the water depth during the works performed, own surveys were used. The average value of nitrogen concentration in the sediments surveyed was below the LOQ of the method applied (i.e. 200 mg·kg⁻¹ DW). The presence of the total nitrogen was confirmed only in 9 samples collected in winter (max. concentration 364 mg·kg⁻¹ DW) and in 14 samples collected in summer (max. concentration 537 mg·kg⁻¹ DW).

This is consistent with the literature data regarding nitrogen content in the Southern Baltic sediments which falls between 98–2604 mg N·kg⁻¹ DW in sandy sediments, 1106–3094 mg N·kg⁻¹ DW in sandy-clayey sediments, 1904–9506 mg N·kg⁻¹ DW in clays and 1694–4606 mg N·kg⁻¹ DW in tills [331]. During own surveys, both in summer and winter the total nitrogen content remained below the LOQ of the method used, i.e. 200 mg·kg⁻¹ DW in 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 [466].

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 Fe³⁺ 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 Fe³⁺ as a result of the decrease in the value of the redox potential [6, 466]. Phosphorus can act as a productivity-limiting factor for the marine ecosystems [487]. 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 [104].

The nutrient 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 10–20% of the total amount of phosphorus contained in the sediments [512]. The average phosphorus concentration in the sediments surveyed was 441 mg·kg⁻¹ DW in winter and 431 mg·kg⁻¹ DW in summer.

The concentrations of POPs (**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 [133]. The accumulation of PAHs and PCBs 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 [43]. Therefore, the phenomenon of desorption of these substances from the sediments into the water is limited. Usually, it is at most 0.5% for the PCB congeners, and up to 5% for the analytes from the PAH group [137, 138]. 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.

The PAHs and PCBs concentrations in the sediments surveyed (dry weight) and their availability are presented in Table 3.1.

Table 3.1. Concentrations of PAHs and PCBs in the seabed sediments analysed [Source: internal materials]

Indicator	Average concentration in the sediments surveyed (calculated as dry weight) [mg·kg ⁻¹ DW]	Available form [%]
Congeners from the PCB group	<0.0001	0.5
Analytes from the PAHs group	0.031	5

Metal concentrations in the sediments surveyed in the BC-Wind 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 [403]. 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 [403, 98, 153, 154].

The labile form of metals may constitute (depending on the type of sediment in the case of individual metals) from 30 to 80% [395, 329, 403, 471, 98, 81]. The results of the analysis of the metal labile form in the sediments surveyed showed that in unfavourable conditions approx. 62% of lead, approx. 37% of copper and approx. 38% of 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. 24% and 17%, respectively.

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

Table 3.2. Mean concentrations of metals in the seabed sediments analysed [Source: internal materials]

Metal	Mean concentration of the total content in the sediments analysed (calculated as dry weight) [mg·kg ⁻¹ DW]	Mean concentration of the available (labile) form [mg·kg ⁻¹ DW]
Lead (Pb)	3.92	2.42
Copper (Cu)	1.64	0.60
Zinc (Zn)	10.03	3.78
Nickel (Ni)	1.84	0.44
Chromium (Cr)	4.94	0.84
Arsenic (Ar)	1.93	<1.25

The concentrations of cadmium ($\text{LOQ} < 0.05 \text{ mg} \cdot \text{kg}^{-1} \text{DW}$), mercury ($\text{LOQ} < 0.01 \text{ mg} \cdot \text{kg}^{-1} \text{DW}$) and TBT ($\text{LOQ} < 0.01 \text{ mg} \cdot \text{kg}^{-1} \text{DW}$) in the sediment surveyed were insignificant, usually below the lower LOQ. Consequently, the risk of water contamination related to the remobilisation of such chemical compounds from the seabed sediment during the construction of the OWF was regarded 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 the presence of raw materials useful for the future operation of the BC-Wind Area, the seismo-acoustic and bathymetric data were analysed.

Based on the analyses of bathymetric and seismo-acoustic data, it is impossible to obtain information on the parameters of accumulations of fine and medium-grained sands, which could constitute a mineral deposit [within the meaning of 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)]. On the greater part of the seabed surface area identified as the seabed with a sandy cover, sands form a layer with a thickness from 0.5 to 2 m, up to, only locally, several meters (the north-eastern part of the area and the part with sandy waves) [Figure 3.4]. 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 a thickness of at least 2 m (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% – these parameters could not be determined from the analyses of bathymetric and seismo-acoustic data alone).

On the basis of the data obtained as part of the environmental surveys conducted, the presence of mineable clastic deposits cannot be excluded. Such an identification requires conducting core sampling to specify the geotechnical parameters of the sediments forming the seabed in the area analysed.

The detailed data on the potential areas of raw material occurrence will be collected as part of further works intended to obtain the building permit. On the basis of these results, the results of the analyses of the nature of the seabed-forming sediments will be presented. The Applicant, when re-assessing the environmental impact, will describe in detail the issue of raw materials including the information on the geotechnical parameters.

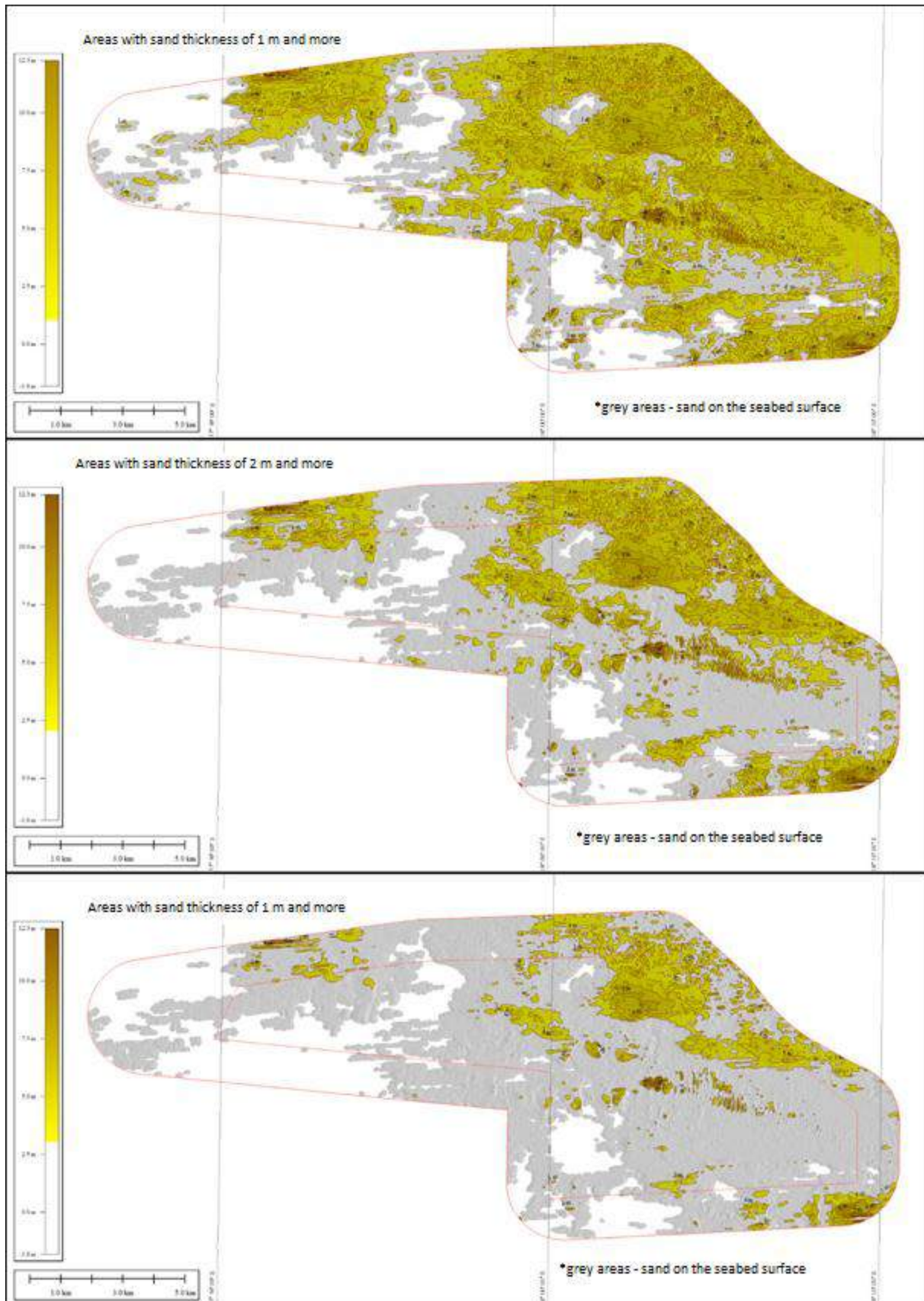


Figure 3.4. Map of sand thickness in the BC-Wind Area [Source: internal materials]

3.3 Seawater quality

The results of tests of individual chemical parameters of the water in the BC-Wind OWF Area, such as pH level, oxygenation, 5-day biochemical oxygen demand (BOD₅), TOC, nutrients, PCBs, PAHs, mineral oil, cyanides, metals, phenols, caesium, and strontium, did not diverge greatly from the values typical for the waters of the Southern Baltic.

These waters were characterised by alkaline pH (pH from 7.28 to 8.26), alkalinity of approx. 1.75 mmol·dm⁻³ and relatively good oxygenation, with seasonal variability characteristic of the Southern Baltic waters. The assessment of the water quality index in the BC-Wind OWF Area, on the basis of the oxygen content in the near-seabed layer in summer (VII/IX), 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·dm⁻³ [237].

Within the entire survey period (November 2019 – September 2020), the average biochemical oxygen demand (BOD₅) in the water samples collected from the BC-Wind OWF Area in individual measurement periods was below 2.00 mg·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 concentrations of suspended solids in the area surveyed were recorded in May and February, whereas the highest ones – in March, which could have been caused by an increased primary production and by the agitation and mixing of waters in the stormy period.

The content of nutrients such as the total nitrogen, mineral nitrogen (total nitrates, nitrites and ammonia), phosphates and the total phosphorus in the waters surveyed was characterised by seasonal variability typical of the waters of the Southern Baltic. The lowest concentrations of the substances surveyed were recorded in the period from May to July, whereas in the winter months (November–February) their significant increase was observed, compliant with the seasonal trend of nutrient level restoration.

The waters of the area surveyed were characterised by low concentrations of particularly harmful substances. Trace concentrations of the following substances were present: 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 values of caesium ¹³⁷Cs and strontium ⁹⁰Sr activity, typical for the waters of the Southern Baltic, which confirms a slow downward trend of ⁹⁰Sr and ¹³⁷Cs concentrations in the Baltic Sea area [516].

Slightly higher PAH concentrations than the ones specified by the data from literature [165, 513] were observed in the BC-Wind OWF Area, which may be due to the differences at the stage of sample preparation for analysis (PAHs concentrations in water were determined 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), the physico-chemical elements analysed in the BC-Wind OWF Area surveyed can be assigned class 1 of water quality (very good status) due to the value of the following indicators in winter: dissolved oxygen, nitrate nitrogen, inorganic nitrogen compounds, DIN and total nitrogen, 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 phosphorus – 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 exceedance of the limit values of the water quality indicators specified in the above-mentioned regulations for PAHs [anthracene, fluoranthene, naphthalene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene] was found. No exceedances of the indicator limit values for the following elements were found: cadmium, lead, mercury and nickel.

Taking into consideration the distance between the BC-Wind OWF Development Area and the nearest surface water body, i.e. Jastrzębia Góra – Rowy CWIIIWB5, which is more than 20.8 km, and the impact range of the project, it should be assumed that the implementation of the BC-Wind OWF will have no impact on the achievement of the environmental objectives for this surface water body.

3.4 Climatic conditions and air quality

3.4.1 Climate and the risk related to climate change

The Southern Baltic sea areas are situated in the humid temperate climate zone with a major influence of the Atlantic Ocean which is due to the prevalent air circulation from the western directions. 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. Characteristic climate components in this area include the prevalence of W, NW and SW winds ranging from weak to strong and very strong during the storm season as well as high air humidity.

In the sea areas and 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). In particular, the comprehensive measurements performed operationally for several decades by IMWM-NRI at stations and measuring points, and for several years also on buoys anchored in the sea could be mentioned. In addition, IMWM-NRI performs monitoring surveys in the Southern Baltic sea areas several times a year, recording the hydrophysical as well as physical and chemical parameters of the sea in a network of designated points. Hydrological and meteorological measurements are also carried out by other scientific and research units. Wind, air temperature and humidity, and also the mean sea level are measured at the Coastal Research Station (CRS) Lubiato, 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, instantaneous 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 parameters of the near-water atmosphere layer as well as hydrophysical and dynamic parameters across the entire water depth have been conducted by the MI GMU as part of various research projects and at the Clients' request.

The surveys presented related to similar measurements carried out by the services and institutions of other Baltic countries allow determining the current trends and forecast the directions of changes in the basic climate parameters of the Southern Baltic. In addition, the information from the simulation calculations of climatological numerical models of the global atmospheric circulation model available from, among others, the research carried out as part of the BALTEX Assessment of Climate Change for the Baltic Sea Basin, Copernicus and other has been extensively used for this purpose.

The climate typical of the coast and the Polish sea areas can be classified as coastal type climate, with small amplitudes of air temperature, high humidity, mild winters, cooler summers, and strong winds. The prevalent wind directions are W and SW. In the open sea areas, including the BC-Wind Area, the climate is characterised by lower amplitudes of air temperature and higher average wind velocity than in the adjacent land areas.

On the basis of the available data and analyses, 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 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. 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. In the southern part, however, the impact of these processes is practically negligible, and the water level is determined mainly by the air circulation in the atmosphere; increased dynamics in the near-water atmosphere layer may result in strong increase in the water level in the littoral zone;
- 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) [293] 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 climate changes observed and projected 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 the 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 accelerating the process of coastal erosion is the warming of winters, and what should be expected as a result, the reduction of the ice cover protecting the beaches from storm surges, and thereby against coastal erosion. The scenarios of sea level changes demonstrate that in the period 2011–2030 the mean annual sea level along the entire coast will be 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 of the average water temperature and an increased inflow of biogenic pollution into the sea (nitrogen and phosphorus compounds), the negative phenomenon will be the progressive eutrophication, especially on the water surface (algae blooms).

The activities undertaken as part of the coastal 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 the 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 basins covering the area of the BC-Wind OWF were determined on the basis of the parameters of the near-water atmosphere layer recorded from October 2019 to January 2021 by an automatic weather station installed on a LIDAR buoy anchored at the H_01 survey station. The conditions are characterised by wind speed and direction, air temperature, pressure and humidity recorded by an automatic atmospheric measurement station (located at 4 MASL). The basic statistical parameters obtained for the period specified are included in Table 3.3.

The presented values of meteorological parameters are consistent with those that could be expected, taking into account the climate characteristics of the Southern Baltic.

Table 3.3. Characteristics of the atmospheric parameters in the near-water layer at the H_01 weather station in the period from 21 October 2019 00:00 h to 09 January 2021 00:00 h [Source: internal materials]

Wind parameter	Value			Standard deviation	Median
	Mean	Minimum	Maximum		
Wind speed [m/s]	7.4	0.0	20.2	-	7.2

Wind parameter	Value			Standard deviation	Median
	Mean	Minimum	Maximum		
Atmospheric pressure [hPa]	1010.0	976.3	1043.1	11.9	1010.5
Air temperature [°C]	9.8	-1.6	23.1	5.3	8.3
Humidity of air [%]	82.5	36.4	99.9	9.6	84.1
Dominant wind direction [°]	W, WSW, SW, SSW				

3.4.3 Air quality

Due to the lack of detailed information on the current parameters of the air quality over the sea areas intended for the construction of the BC-Wind OWF, the air quality assessment of the layer of the atmosphere near the water surface is compared with the information obtained as part of the measurements carried out by the Inspection for Environmental Protection as part of the State Environmental Monitoring for the nearest coastal research station (Łeba). It should be noted that due to the lack of significant sources of pollution emission over the sea area (industry, cities), the parameters of air quality should not be worse than those measured at the shore. Although the impact of air pollution caused by ships should be taken into account, it can be expected that the creation of the emission control area (SECA/ECA) in the Baltic Sea, air quality over the Baltic Sea will improve. This is indicated by the results of the ENVISUM project [189].

The assessment of air quality in Poland, including at shore stations, has been 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 Poland, the tasks related to conducting surveys and assessments of the state of the environment, including air quality monitoring, are carried out by the Inspection of Environmental Protection under the National Environmental Monitoring, whose program is developed by the Chief Inspector of Environmental Protection and approved by the Minister of the Environment. As part of this program, the tasks related to the fulfilment of the requirements contained in EU regulations and in Polish law as well as in international conventions signed and ratified by Poland are implemented.

Due to the fact that the monitoring of air quality is conducted only in onshore areas, the results obtained from the measurements for the Pomeranian Voivodeship, and in particular for the coastal zone, have been taken as the reference level for the offshore 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 2015.

In the sea areas, which cover the areas of the planned OWF, no measurements have been made to assess the air quality in terms of their greenhouse gas content, dust concentrations 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 (SO₂) – the fourth maximum 24-hour concentration in 2018 amounted to 5 µg·m⁻³ with a permissible value of 125 µg·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 $5 \mu\text{g}\cdot\text{m}^{-3}$ with a permissible value of $40 \mu\text{g}\cdot\text{m}^{-3}$; this is the lowest value recorded in the Pomeranian Voivodeship;
- ozone (O_3) – the number of days with an exceedance of the 8-hour average was 12, with the assumed target value of $120 \mu\text{g}\cdot\text{m}^{-3}$ – 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 parameters recorded means that the onshore area in the coastal zone near Łeba has air quality class A. Similar values should be expected for the near-shore areas. Furthermore, these sea areas are located away from onshore sulphur dioxide and nitrogen dioxide emission sources; hence, these substances are emitted solely by ships and the emission size depends on the ship type and traffic intensity. The area of the BC-Wind OWF is devoid of any terrain obstacles impeding the propagation of these substances. Therefore, the average concentrations in the air of the compounds mentioned above 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 of the BC-Wind OWF [Figure 3.5], 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, due to the creation of emission control zones (SECA/ECA) in the Baltic Sea.

In the case of O_3 concentration, which has a higher value in the coastal area 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 a continued O_3 concentration is due largely to natural causes.

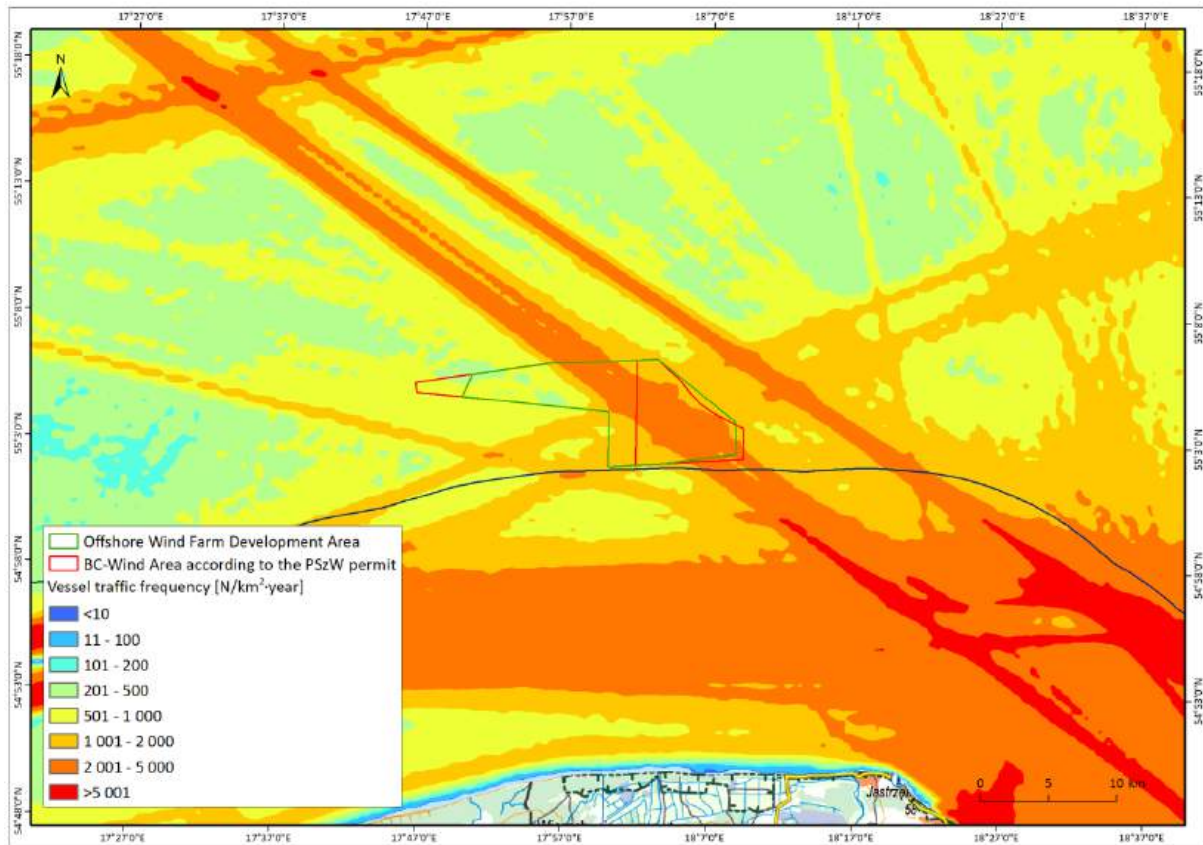


Figure 3.5. Distribution of pollutant emissions from vessels in the vicinity of the BC-Wind OWF in the years 2018–2019; darker colour means greater relative emission from the combustion of vessel fuels [Source: internal materials based on AIS data]

3.5 Ambient noise

To determine the initial level of ambient noise, noise monitoring was conducted using a SM4M Wildlife Acoustics autonomous sound recorder.

The results of ambient noise monitoring conducted in the period from December 2019 to January 2021 in the BC-Wind OWF Area, show that the levels of underwater noise (and their variability ranges) indicate values characteristic for the Southern Baltic area [219, 300].

The comparison of the results obtained with the model data acquired using the BIAS platform Soundscape Planning Tool [132, 481] for the BC-Wind OWF Area, indicated that the ambient noise monitoring results 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 season. The results obtained also indicate a good concordance with the results of the noise level studies, which were conducted in the neighbouring OWF areas: Bałtyk II, Bałtyk III, Baltica or Baltic Power OWFs.

More details are provided 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). From the natural fields, the geomagnetic field of the Earth, the intensity of which ranges from 16 to 56 A·m⁻¹, is best recognised. 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 $120 \text{ V}\cdot\text{m}^{-1}$.

In the marine environment, the values of the electric field and the geomagnetic field are similar. In the BC-Wind 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. 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 the PMA [239].

3.7 Description of natural elements and protected areas

3.7.1 Biotic elements in the maritime area

3.7.1.1 Phytobenthos

The surveys carried out in the area of the planned BC-Wind OWF and in the 1 NM zone from the boundary of this area showed a lack of underwater vegetation attached to boulders and stones lying on the seabed. The previous surveys 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 [126, 234, 153, 154, 328]. The minimum depth of the seabed in the survey area is 28 m, which is below the range of the phytobenthos occurrence. Therefore, it should be assumed that phytobenthos does not occur in the entire BC-Wind OWF Area.

3.7.1.2 Macrozoobenthos

Macrozoobenthos (benthic macrofauna) is a group of invertebrate organisms inhabiting the seabed sediments (infauna) or the surface layer of the seabed sediments (epifauna), as well as the hard substratum (boulders, stones), which remain on a sieve with a 1 mm mesh size during sediment rinsing. These are mostly sessile organisms with a life-cycle of at least one year. The macrozoobenthos composition includes marine, brackish water and fresh water species mainly of the Bivalvia, Crustacea, Polychaeta, Oligochaeta and the Gastropoda divisions. Moreover, periphytic organisms such as bryozoans (Bryozoa) or hydrozoans (Hydrozoa) appear often on the hard substrate. Macrozoobenthos plays an important role in the trophic network of marine ecosystems as food for many species of fish and seabirds. The eggs and larvae of bivalves are food for zooplankton and fish larvae. Benthic fauna shapes the living conditions of other organisms (the habitat-forming role of bivalves, providing shelter for the accompanying fauna) and affects the state of the environment (e.g. bioturbation of burrowing organisms positively transforms the physical and geochemical structure of the sediment and influences its oxygenation; biofiltration of suspended solids from the water by bivalves cleans the near-seabed water and reduces the effects of eutrophication). Benthic invertebrates can be a sensitive bioindicator of the environment, since the taxonomic diversity, abundance, biomass and sensitivity of individual taxa composing the benthic organism complex indicates the ecological quality of the seabed [518, 13, 491, 288, 496, 320, 433].

For the purposes of this report, separate surveys of macrozoobenthos from the soft bottom (sandy and gravelly sediments) and from the hard bottom (stones) were conducted. 21 taxa representing two phyla and 6 divisions were found in the macrozoobenthos samples collected from the soft bottom in the BC-Wind OWF Area (1 NM). The most common taxa were the three species of polychaetes: *Pygospio elegans*, *Marenzelleria* sp. and *Bylgides sarsi*, one species of bivalves – *Limecola balthica* and a representative of the malacostracans – *Diastylis rathkei*. On the hard bottom, 17 taxa belonging to 7 divisions were found among periphytic and phytophilic fauna. The most common taxa were: the polychaete *Bylgides sarsi*, the bivalves *Mytilus trossulus*, *Einhornia crustulenta* (bryozoans), *Gonothyrrea loveni* (hydrozoan) and the crustacean *Jaera (Jaera) albifrons*.

The BC-Wind OWF Area is situated in the Eastern Gotland Basin. The area in which the project is to be implemented has not been investigated with regard to macrozoobenthos until the inventory surveys conducted in 2020. The two nearest macrozoobenthos survey stations, on the basis of which the assessment of the environmental status is performed in the Polish Maritime Areas (PMA) according to the provisions of the Water Law Act (Journal of Laws of 2018, item 2268) and in accordance with the provisions of Art. 11 of the Directive 2008/56/WE of the European Parliament and of the Council of 17 June 2008, as part of the State Environmental Monitoring (SEM), are located approximately 19.5–53 km from the boundaries (1 NM) of this area. Therefore, it is impossible to determine the nature and direction of changes that have taken place over the years in the taxonomic and quantitative structure of the macrozoobenthos communities in the area of the planned OWF.

On the other hand, a limited comparative material to assess the taxonomic composition and stability of the macrozoobenthos occurrence on the soft bottom in the BC-Wind OWF Area in 2020 may be the results of macrozoobenthos surveys from the areas of other planned OWFs such as the Baltica 3 OWF located the closest (approx. 12 km from the BC-Wind OWF) [25], next the Bałtyk III OWF located approx. 18 km away from the BC-Wind OWF [154], and the Baltica 2 OWF located further away from the BC-Wind OWF (at a distance of approx. 30 km; [25]) and lastly the Bałtyk II OWF (at a distance of approx. 50 km; [153]). The compilation of the results of the macrozoobenthos surveys carried out as part of the above-mentioned projects in 2013–2016, in a slightly narrower range of depths (21–54 m) on the soft bottom in the open waters of the Southern Baltic is presented in Table 3.4.

Table 3.4. Characteristics of the surveys of macrozoobenthos from the soft bottom in the BC-Wind OWF Area conducted in 2020 compared with the results of the macrozoobenthos surveys conducted in the area of the following OWFs: Bałtyk III and Bałtyk II in 2013 and 2014 as well as Baltica 2 and Baltica 3 in 2016 [Source: internal materials]

Parameter	Bałtyk III OWF Area (2013)	Bałtyk II OWF Area (2013, 2014)	Baltica 2, Baltica 3 OWF Area (2016)	BC-Wind OWF Area (2020)
Number of stations	175	117	402	146
Depth [m]: (range)	26-42	23-44	21-54	30-63
Number of taxa: max., range	27; 4–16	32; 3-12	33; 4-18	21; 4-13
Taxa recorded most often	<i>Pygospio elegans</i> , <i>Marenzelleria</i> sp., <i>Limecola balthica</i> , <i>Hediste diversicolor</i> ,	<i>Pygospio elegans</i> , <i>Marenzelleria</i> sp.	<i>Marenzelleria</i> sp., <i>Pygospio elegans</i> , <i>Limecola balthica</i> , <i>Bylgides sarsi</i> , <i>Diastylis rathkei</i> ,	<i>Pygospio elegans</i> , <i>Marenzelleria</i> sp., <i>Limecola balthica</i> , <i>Diastylis rathkei</i> , <i>Bylgides sarsi</i>
Taxa recorded most often	<i>Pygospio elegans</i> , <i>Marenzelleria</i> sp.,	<i>Pygospio elegans</i> , <i>Marenzelleria</i> sp.	<i>Marenzelleria</i> sp., <i>Pygospio elegans</i> ,	<i>Pygospio elegans</i> , <i>Marenzelleria</i> sp.,

Parameter	Bałyk III OWF Area (2013)	Bałyk II OWF Area (2013, 2014)	Baltica 2, Baltica 3 OWF Area (2016)	BC-Wind OWF Area (2020)
	<i>Limecola balthica</i> , <i>Hediste diversicolor</i> ,		<i>Limecola balthica</i> , <i>Bylgides sarsi</i> , <i>Diastylis rathkei</i> ,	<i>Limecola balthica</i> , <i>Diastylis rathkei</i> , <i>Bylgides sarsi</i>

In the Bałyk III OWF Area and its one-mile-wide buffer zone, 175 samples of macrozoobenthos were collected from the sandy seabed using a van Veen grab sampler. As a result of the surveys carried out, the occurrence of 27 taxa of macrozoobenthos was confirmed. In June 2013 and in May 2014, in the Bałyk II OWF Area and its one-mile-wide buffer zone, 117 samples of macrozoobenthos were collected from the sandy seabed. As a result of the surveys carried out, the occurrence of 32 taxa of macrozoobenthos has been established. The results of macrozoobenthos surveys conducted in May, June and July 2016, in the Baltica 2 OWF and Baltica 3 OWF Areas, based on 402 samples of macrozoobenthos collected in total from the sandy seabed indicate the occurrence of 33 macrozoobenthos taxa in this area. On the other hand, the taxonomic composition determined as a result of the surveys conducted in the BC-Wind OWF Area in 2020 was slightly poorer (21 taxa) than that recorded in the areas of the Bałyk III and Bałyk II OWFs as well as the Baltica2 and Baltica3 OWFs, but similar in terms of the most frequently recorded taxa (absolutely constant). This is probably due to the close location of the planned projects, a similar type of the seabed sediment and a similar depth range.

The multimetric index B was used to assess the quality status of the soft bottom macrozoobenthos communities, while the TSP index was used for the hard bottom.

The sandy seabed (sands, gravels) covers the largest part of the planned BC-Wind OWF Area (1 NM). The valorisation carried out has shown that the macrozoobenthos found on the soft bottom did not have high natural value and the quality status of macrozoobenthos communities was assessed as moderate. Moreover, on the soft bottom in the northern and southern parts of the planned project, the presence of small fragments of the seabed with macrozoobenthos of "good" or even "very good" ecological status was found. On the other hand, the status of the macrozoobenthos communities within the seabed fragments covered with stones (up to 5% of the seabed surface in the survey area), found mainly in the western and southern parts of the OWF Area (1 NM), is assessed as moderate or good. The boulder areas covered with periphyton occur in the vast majority only in the buffer zone (1 NM), and not in the actual Development Area. The Development Area will not include the western part of the planned project area, in which a stony seabed was found. The quality status of the macrozoobenthos communities within the BC-Wind OWF Area is presented on the map [Figure 3.6].

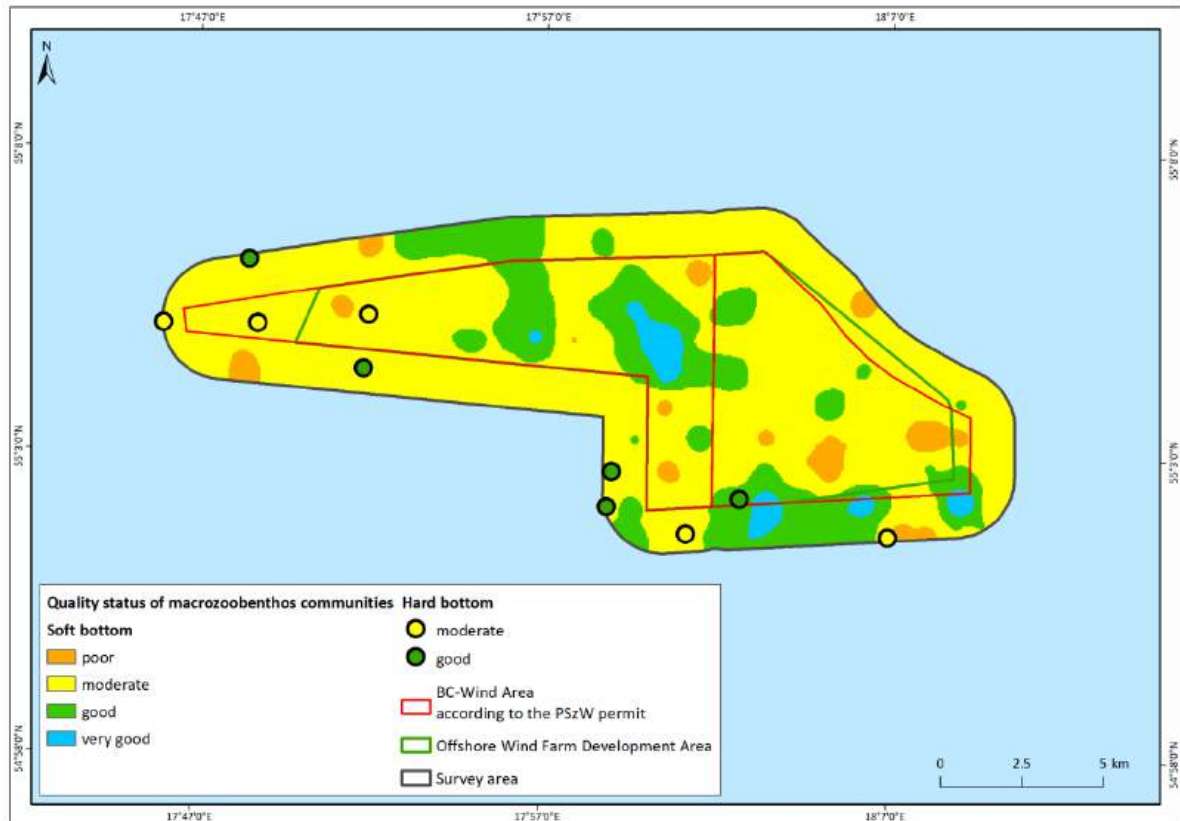


Figure 3.6. Spatial distribution of the macrozoobenthos communities quality status within the BC-Wind OWF Area (1 NM) [Source: internal materials]

3.7.1.3 Ichthyofauna

The ichthyofauna surveys were conducted in the BC-Wind 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 and included 4 survey campaigns covering all seasons of the year.

During the pelagic control hauls aimed at investigating the proportions of individual species for the purposes of estimating pelagic fish biomass, apart from herring and sprat, also a few specimens of garfish, three-spined stickleback, great sand eel, cod, anchovy, flounder, lumpfish, and lesser sand eel were caught.

The result of demersal catches conducted in the BC-Wind OWF Area using bottom-set nets was 1645.51 kg of fish belonging to 13 taxa. Flounder and cod dominated, whereas other species were a small by-catch (great sand eel, plaice, shorthorn sculpin, pogge, mackerel, fourbeard rockling, turbot, herring, sprat, lumpfish, viviparous eelpout).

Fish belonging to 21 taxa were caught in all the survey gear in the OWF Area [Table 3.5]. Permanent fish communities included cod, flatfish, 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 adult individuals.

Table 3.5. Specification of all the taxa recorded in the course of survey catches in the BC-Wind OWF Area [Source: internal materials]

No.	Species	Pelagic catches	Demersal catches	Ichthyoplankton catches
1.	Garfish <i>Belone belone</i>	X		
2.	Three-spined stickleback <i>Gasterosteus aculeatus</i>	X		
3.	Great sand eel <i>Hyperoplus lanceolatus</i>	X	X	X
4.	Cod <i>Gadus morhua</i>	X	X	X
5.	Plaice <i>Pleuronectes platessa</i>		X	
6.	Shorthorn sculpin <i>Myoxocephalus scorpius</i>		X	
7.	Pogge <i>Agonus cataphractus</i>		X	
8.	Mackerel <i>Scomber scombrus</i>		X	
9.	Fourbeard rockling <i>Enchelyopus cimbrius</i>		X	X
10.	European anchovy <i>Engraulis encrasicolus</i>	X		
11.	Turbot <i>Scophthalmus maximus</i>		X	
12.	Flounder <i>Platichthys flesus</i>	X	X	X
13.	Sprat <i>Sprattus sprattus</i>	X	X	X
14.	Herring <i>Clupea harengus</i>	X	X	X
15.	Lumpfish <i>Cyclopterus lumpus</i>		X	
16.	Lesser sand eel <i>Ammodytes tobianus</i>	X		
17.	Viviparous eelpout <i>Zoarces viviparus</i>		X	
18.	Gobies <i>Gobiidae</i>			X
19.	Longspined bullhead <i>Taurulus bubalis</i>			X
20.	Rock gunnel <i>Pholis gunnellus</i>			X
21.	Common sea snail <i>Liparis liparis</i>			X

The BC-Wind OWF Area is characterised by an ichthyofauna composition typical of the Southern Baltic waters, with a clear predominance of cod and flounder in demersal catches, and herring and sprat in pelagic catches.

The results obtained indicate that during the survey period, the area of the planned project provided a habitat for **herring**, as well as that the migration routes leading towards wintering grounds as well as the spawning (probably) and feeding migration routes run across the area.

The area of the planned project constitutes a part of a sea area in which temporary spawning as well as feeding ground migrations of **sprat** took place and the latter migrations intensified in autumn.

Taking into consideration the information available in literature and the results of surveys conducted, it can be assumed that the sprat spawning can take place in the BC-Wind OWF Area, the intensity of which is relatively low, when compared to other shallow-water areas.

The area of the planned project was characterised by the prevalence of young, small **cod** (<35 cm) throughout all survey seasons of 2019. The survey area is located on the spawning and feeding migration routes of cod.

The area of the planned project provides temporary habitat for adult **flounder**. Flounder do not spawn directly within the survey area, since the salinity prevailing there is too low to enable successful fertilisation.

Concluding, out of the 21 taxa observed during the ichthyofauna surveys carried out for the purpose of the planned project, 4 are of particular economic importance in terms of commercial fishing. These are: sprat, herring, cod, and flounder. Salmon and sea trout were not observed during the survey catches (no standardised survey methods, low density), however, these two species are found in commercial fishing.

In the survey catches conducted in the BC-Wind OWF Area, the most numerous were: sprat, herring, cod and flounder.

Two taxa of the fish larvae recorded – gobies and common seasnail – belong to the **partially protected species** pursuant to the Regulation of the Minister of the Environment of 16 December 2016 (Journal of Laws of 2016, item 2183, as amended). Their frequency of occurrence was as follows: gobies – two survey seasons (autumn and summer), common seasnail – one survey season (spring). Although gobiid larvae were not identified to species, on the basis of the knowledge from literature and random observations, it can be assumed that the protected sand goby was the dominant species in the samples collected.

To assess the significance of the BC-Wind OWF Area with respect to ichthyofauna, its following values were considered: taxonomic diversity, occurrence of protected and endangered as well as commercial species, the presence of feeding or spawning grounds, and migration routes. On the basis of the above-mentioned functions, the natural values of this area were assessed as moderate. This evaluation was made based on 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 BC-Wind OWF Area: the harbour porpoise (*Phocoena phocoena*), the grey seal (*Halichoerus grypus*) and the harbour seal (*Phoca vitulina*). There

is a very low probability of the ringed seal presence (*Pusa hispida*), therefore, the assessment focuses on the three species mentioned above.

The **harbour porpoise** (*Phocoena phocoena*) is the only representative of cetaceans in the Baltic Sea. On the basis of the SAMBAH project from 2013, its abundance in the Baltic Proper was estimated at 80–1091 individuals [398]. The exact status of the harbour porpoise population in the Polish part of the Baltic Sea is unknown, although its abundance is generally considered to be very low [142, 225]. According to the data from the SAMBAH project, the Polish Maritime Areas belong to the waters with low density of this species, with a higher detection probability in the period from November to April than in the period from May to October [Figure 3.7] [398]. In the environmental survey for the BC-Wind OWF, not many detections of the harbour porpoise have been recorded, with a higher number falling in the period between May and October than between November and April [Figure 3.8].

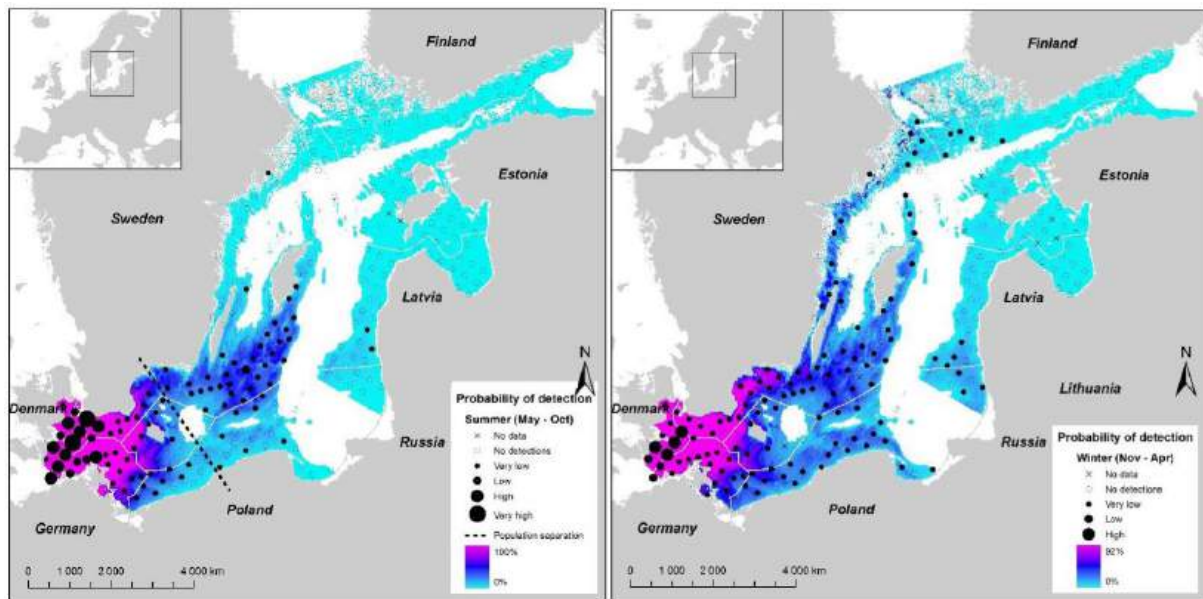


Figure 3.7. Probability of detecting harbour porpoises in the period between May and October (left panel), and between November and April (right panel), obtained from the SAMBAH project (2011–2013) [398]

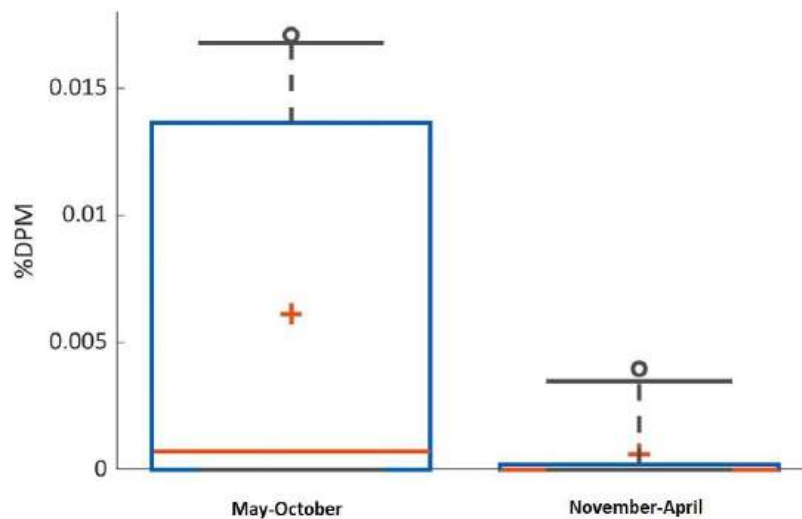


Figure 3.8. Boxplot presenting the activity of the harbour porpoise (% DPM) in the BC-Wind project, between May and October, and also between November and April (annual division applied in the SAMBAH project), in the entire monitoring period. The red cross represents the mean value, the red horizontal line 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). Whiskers represent the maximum and minimum values [Source: internal materials]

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” have indicated the harbour porpoise detection in the area of the Pomeranian Bay and the Stilo Bank in the years 2016–2018. In the area of the Pomeranian Bay, the average DPD values expressed as a percentage (%DPD) have been recorded at a level of 4.56%DPD, and in the case of the Stilo Bank at 0.32%DPD [262]. Moreover, the analyses of the data collected have indicated differences in the harbour porpoise occurrence seasonality. The highest DPD values in the Pomeranian Bay were recorded in summer, while in the area of the Stilo Bank the highest values were recorded in spring [262]. In the BC-Wind OWF Area (2 NM), the average %DPD from all stations was 0.61 (=17 DPD for all 2790 days of monitoring in total) [Figure 3.9] with the most common detection of this species falling in the summer (0.01% DPM on average) [Figure 3.10].



Figure 3.9. The acoustic activity of the harbour porpoise expressed as average %DPD, obtained from the projects entitled “Pilot implementation of species and marine habitats monitoring in 2015–2018” (the harbour porpoise monitoring was conducted in the years 2016–2018) in the Pomeranian Bay and the Stilo Bank [262] and the environmental surveys conducted for the BC-Wind OWF in the years 2019–2021 [Source: internal materials]

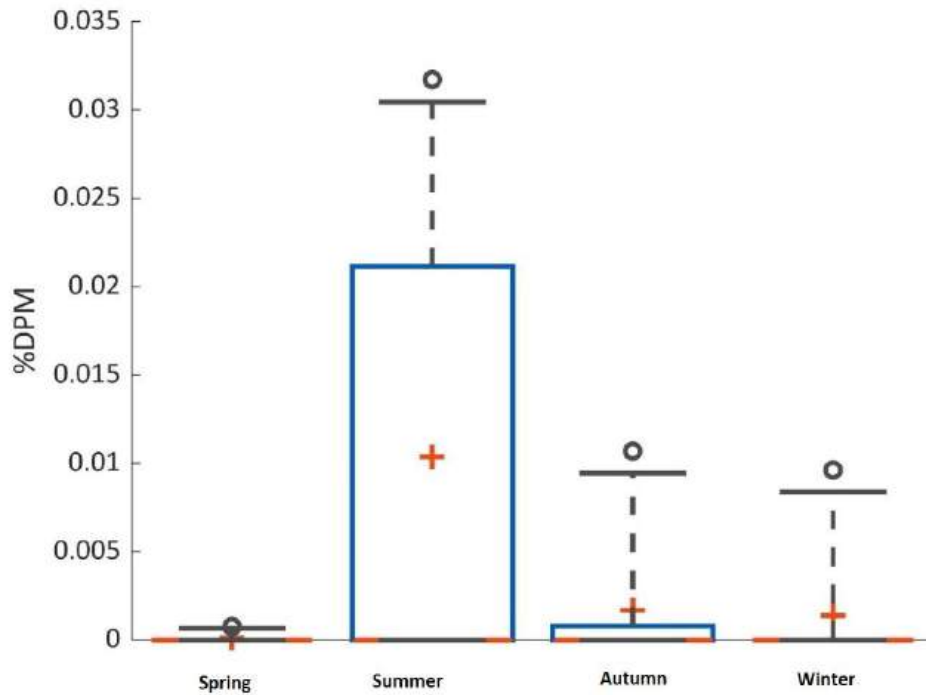


Figure 3.10. Boxplot presenting the activity of the harbour porpoise (%DPM) for every season of the year, within the entire BC-Wind OWF Area. The red cross represents the mean value, the red horizontal line the median (the 50th percentile); the lower edge of the box represents the lower quartile (the 25th percentile), the upper edge of the box represents the upper quartile (the 75th percentile). Whiskers represent the maximum and minimum values [Source: internal materials]

The monitoring conducted as part of the cooperation between WWF Poland and the Hel Marine Station of the Institute of Oceanography of the University of Gdańsk (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 2011–2021, 60 dead individuals of the harbour porpoise were found on the Polish coast, while, one observation was made within 30 km from the BC-Wind OWF Area [Figure 3.11] [515].

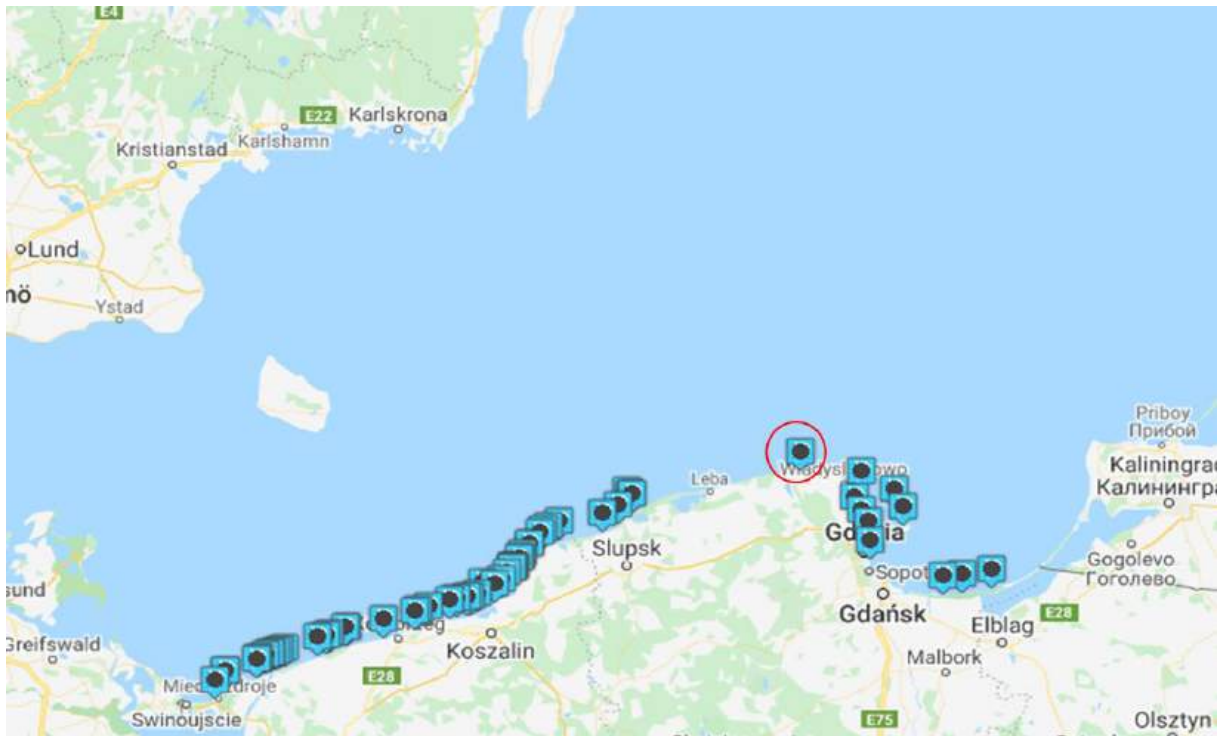


Figure 3.11. Harbour porpoise observations at the Polish coast in the period from January 2011 to January 2021. The red circle represents a 1 harbour porpoise observation at a distance of 30 km from the BC-Wind OWF Area [Source: [515]]

During the surveys carried out between October 2019 and January 2021 for the purposes of the EIA Report for the BC-Wind 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, 5 main and 2 additional acoustic devices were located, which were continuously detecting the sounds emitted by the harbour porpoise.

The highest DPM values were recorded at the CPOD_03 station in summer (42 DPM). Harbour porpoises were recorded at all stations except the CPOD_01 and CPOD_04 stations. The highest daily activity of the harbour porpoise was recorded on 17 August 2020 (18 DPM) at the CPOD_06 station, where it reached 1.52%DPM [Figure 3.12]. The number of porpoise clicks recorded was low. During the observation flights and the observations from aboard vessels conducted as part of the seabird surveys, no harbour porpoises were seen.

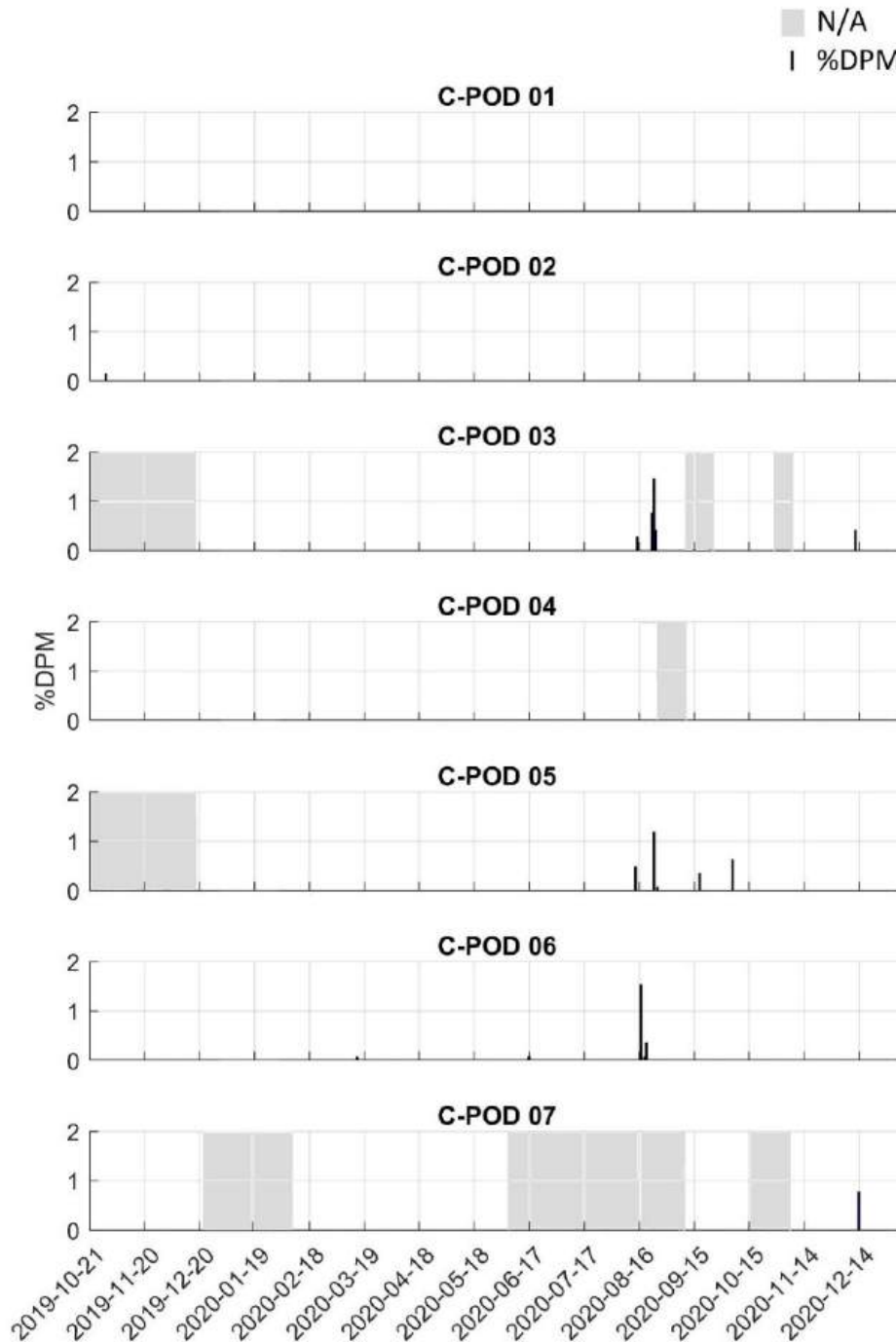


Figure 3.12. Harbour porpoise daily activity at seven survey stations in the BC-Wind OWF Area (2 NM). The activity is expressed as percentage of detection positive minutes (%DPM). Periods with no data are marked in grey [Source: internal materials]

There are three species of **seals** occurring in the Baltic Sea. The number of the Baltic grey seal has exceeded 32 000 individuals [169]. On the other hand, the subpopulation of the Baltic harbour seal is estimated at 1563 individuals [NOVANA census, Jonas Teilmann – personal communication]. The abundance of the ringed seal is estimated at a level of 10 000 individuals [169]. 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 [169].

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 (66% of observations), next was the harbour seal (5% of observations) and the ringed seal (2% of observations) [Figure 3.13] [515].

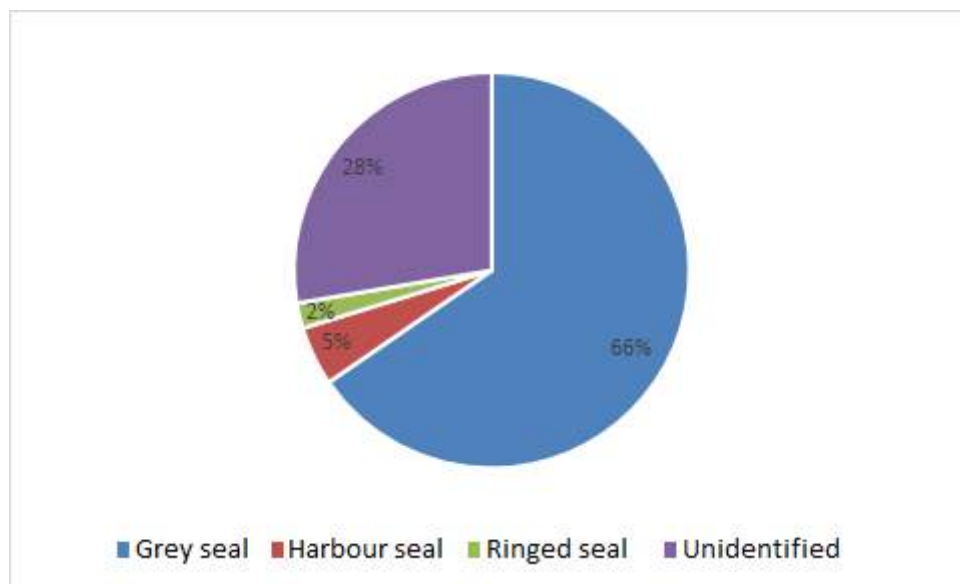


Figure 3.13. Division of the results of seal observations at the Polish coast, obtained in the period from 01 January 2011 to 1 January 2021, on the basis of the database maintained by WWF Poland and the Hel Marine Station IO UG as part of the project “Support for the restitution and protection of Baltic mammals in Poland” and “Protection of marine mammal and seabird habitats” [515] [Source: internal materials]

The highest number of grey seals is recorded in the vicinity of the Vistula Cut estuary, where the species finds good conditions for resting. 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 the grey seal haul-outs in the area of the Vistula Cut estuary. In the period discussed, the number of grey seals equalled on average about 200 individuals during the moulting period [262]. During the observations, a single individual of the harbour seal was recorded at the haul-out, no individuals of the ringed seal were observed [262].

During the period of monitoring for the BC-Wind OWF (between October 2019 and January 2021), the WWF Poland Blue Patrol recorded the observations of 11 live and 4 dead individuals of this species, along the coast at a distance of approx. 30 km away from the BC-Wind OWF Area. Other species of seal were not observed [Table 3.6].

Table 3.6. Results of seal observations at the Polish coast in the area approx. 30 km away from the BC-Wind OWF, obtained in the period from 21 October 2019 to 07 January 2021 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” [515] [Source: internal materials]

Species	Number of live individuals	Number of dead individuals	Total
Grey seal	11	4	15
Harbour seal	0	0	0
Ringed seal	0	0	0
Unidentified	0	0	0

During the monitoring of seabirds from aboard vessels for the BC-Wind OWF project, 28 observations of seals, including 21 observations of the grey seal, were made. Directly in the BC-Wind OWF Area (2 NM), 9 observations of seals (7 identified as grey seals) were made [Figure 3.14]. It is possible that the same individual was identified multiple times. Moreover, probably 7 observations of the grey seal in the OWF Area concerned seals from the haul-out in the area of the Vistula Cut estuary. This is confirmed by the results of seal observations conducted during the seabird surveys carried out from aboard vessels as part of the BC-Wind project. Taking into consideration the total research effort (>2000 km), it can be concluded that grey seals can be encountered in the BC-Wind OWF Area throughout the year, but their number is relatively low.

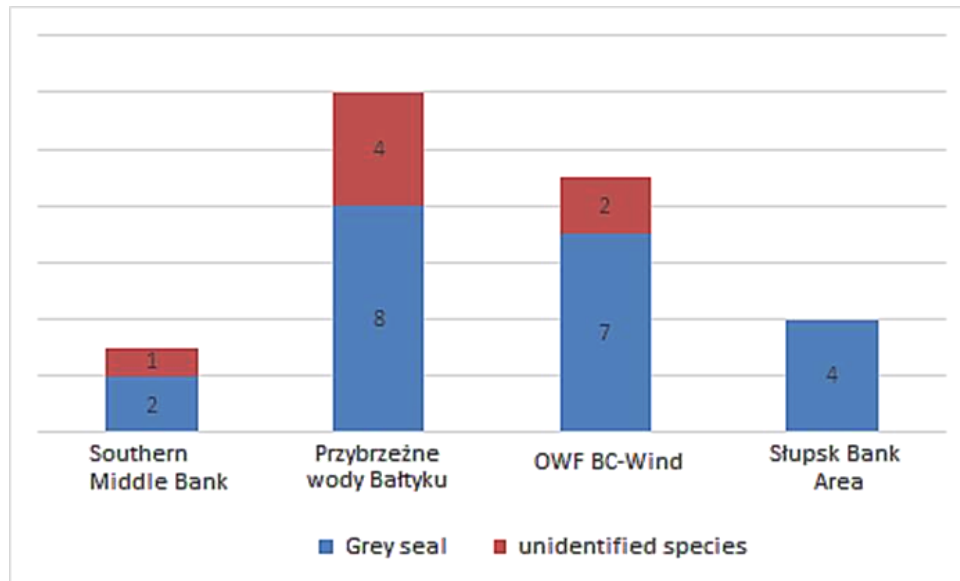


Figure 3.14. Summary of marine mammal observations during seabird surveys [Source: internal materials]

In the period between October 2019 and January 2021, as part of the environmental monitoring in the BC-Wind OWF Area (2 NM), 6 observation flights were carried out, during which no seals were seen in the survey area.

The results of the harbour porpoise acoustic monitoring, aerial visual observations and observations of marine mammals conducted from aboard survey vessels 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 most abundant migratory birds observed during the surveys included sea ducks [common scoter (*Melanitta nigra*), velvet scoter (*Melanitta fusca*) and long-tailed duck (*Clangula hyemalis*)], geese (identified to the family level), and passerines (identified to the order level). The migratory birds observed were classified in 93 categories, 75 of which were birds identified to the species level. Table 3.7 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 the 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: internal materials]

No.	Species	Number of individuals	Species protection in Poland ¹	Annex I of the EU Birds Directive	IUCN ²	HELCOM ³
1.	Common scoter <i>Melanitta nigra</i>	828	P	No	LC	EN
2.	Velvet scoter <i>Melanitta fusca</i>	531	P	No	VU	VU
3.	Long-tailed duck <i>Clangula hyemalis</i>	477	P	No	VU	EN
4.	Eurasian skylark <i>Alauda arvensis</i>	419	P	No	LC	-
5.	Common wood pigeon <i>Columba palumbus</i>	403	G	No	LC	-
6.	Razorbill <i>Alca torda</i>	328	P	No	NT	-
7.	Bean goose <i>Anser fabalis</i>	290	G	No	LC	EN
8.	Great black cormorant <i>Phalacrocorax carbo</i>	244	PP	No	LC	-
9.	Common starling <i>Sturnus vulgaris</i>	184	P	No	LC	-
10.	Eurasian siskin <i>Carduelis spinus</i>	159	P	No	LC	-
11.	Eurasian wigeon <i>Mareca penelope</i>	147	P	No	LC	-
12.	White wagtail <i>Motacilla alba</i>	129	P	No	LC	-
13.	Common chaffinch <i>Fringilla coelebs</i>	124	P	No	LC	-
14.	Black-headed gull <i>Larus ridibundus</i>	114	P	No	LC	-
15.	Lesser black-backed gull <i>Larus fuscus</i>	113	P	No	LC	VU
16.	Common gull <i>Larus canus</i>	112	P	No	LC	-
17.	Little gull <i>Hydrocoloeus minutus</i>	106	P	Yes	NT	NT
18.	Greylag goose <i>Anser anser</i>	103	G	No	LC	-
19.	Common guillemot <i>Uria aalge</i>	96	P	No	NT	-
20.	Black-throated diver <i>Gavia arctica</i>	48	P	Yes	LC	CR
21.	Common teal <i>Anas crecca</i>	45	G	No	LC	-

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No.	Species	Number of individuals	Species protection in Poland ¹	Annex I of the EU Birds Directive	IUCN ²	HELCOM ³
22.	Barn swallow <i>Hirundo rustica</i>	41	P	No	LC	-
23.	Common crane <i>Grus grus</i>	34	P	Yes	LC	-
24.	Greater scaup <i>Aythya marila</i>	24	P	No	VU	VU
25.	Mute swan <i>Cygnus olor</i>	23	P	No	LC	-
26.	Eurasian curlew <i>Numenius arquata</i>	20	P	No	VU	-
27.	Northern shoveler <i>Spatula clypeata</i>	20	P	No	LC	-
28.	Common swift <i>Apus apus</i>	18	P	No	LC	-
29.	Common goldeneye <i>Bucephala clangula</i>	16	P	No	LC	-
30.	Tufted duck <i>Aythya fuligula</i>	14	G	No	LC	NT
31.	Great black-backed gull <i>Larus marinus</i>	14	P	No	LC	-
32.	Northert pintail <i>Anas acuta</i>	13	P	No	LC	-
33.	Red-breasted merganser <i>Mergus serrator</i>	13	P	No	NT	-
34.	Mallard <i>Anas platyrhynchos</i>	9	G	No	LC	-
35.	Red-throated diver <i>Gavia stellata</i>	8	P	Yes	LC	CR
36.	Dunlin <i>Calidris alpina</i>	8	P	Yes	LC	EN
37.	Parasitic jaeger <i>Stercorarius parasiticus</i>	8	P	No	LC	-
38.	Greater white-fronted goose <i>Anser albifrons</i>	7	G	No	LC	-
39.	Goosander <i>Mergus merganser</i>	7	P	No	LC	-
40.	Black tern <i>Chlidonias niger</i>	6	P	Yes	LC	-
41.	Common kestrel <i>Falco tinnunculus</i>	6	P	No	LC	-
42.	Western yellow wagtail <i>Motacilla flava</i>	6	P	No	LC	-
43.	Goldcrest <i>Regulus regulus</i>	6	P	No	LC	-
44.	Grey heron <i>Ardea cinerea</i>	5	PP	No	LC	-

No.	Species	Number of individuals	Species protection in Poland ¹	Annex I of the EU Birds Directive	IUCN ²	HELCOM ³
45.	Whooper swan <i>Cygnus cygnus</i>	5	P	Yes	LC	-
46.	Common house martin <i>Delichon urbicum</i>	4	P	No	LC	-
47.	Common tern <i>Sterna hirundo</i>	4	P	Yes	LC	-
48.	Eurasian sparrowhawk <i>Accipiter nisus</i>	3	P	No	LC	-
49.	Great tit <i>Parus major</i>	3	P	No	LC	-
50.	Rook <i>Corvus frugilegus</i>	2	P	No	LC	-
51.	European robin <i>Erithacus rubecula</i>	2	P	No	LC	-
52.	Brambling <i>Fringilla montifringilla</i>	2	P	No	LC	-
53.	Woodlark <i>Lullula arborea</i>	2	P	Yes	LC	-
54.	Smew <i>Mergus albellus</i>	2	P	Yes	LC	-
55.	European honey buzzard <i>Pernis apivorus</i>	2	P	Yes	LC	-
56.	Great crested grebe <i>Podiceps cristatus</i>	2	P	No	LC	-
57.	Common eider <i>Somateria mollissima</i>	2	P	No	VU	-
58.	Little grebe <i>Tachybaptus ruficollis</i>	2	P	No	LC	-
59.	Mediterranean gull <i>Larus melanocephalus</i>	1	P	Yes	LC	EN
60.	Great egret <i>Ardea alba</i>	1	P	Yes	LC	-
61.	Short-eared owl <i>Asio flammeus</i>	1	P	Yes	LC	-
62.	Long-eared owl <i>Asio otus</i>	1	P	No	LC	-
63.	Common linnet <i>Carduelis cannabina</i>	1	P	No	LC	-
64.	Twite <i>Carduelis flavirostris</i>	1	P	No	LC	-
65.	Jackdaw <i>Corvus monedula</i>	1	P	No	LC	-
66.	Merlin <i>Falco columbarius</i>	1	P	Yes	LC	-
67.	Peregrine falcon <i>Falco peregrinus</i>	1	P	Yes	LC	-

No.	Species	Number of individuals	Species protection in Poland ¹	Annex I of the EU Birds Directive	IUCN ²	HELCOM ³
68.	Red-footed falcon <i>Falco vespertinus</i>	1	P	Yes	NT	-
69.	Great grey shrike <i>Lanius excubitor</i>	1	P	No	VU	-
70.	Northern wheatear <i>Oenanthe oenanthe</i>	1	P	No	LC	-
71.	Pomarine skua <i>Stercorarius pomarinus</i>	1	P	No	LC	-
72.	Eurasian wren <i>Troglodytes troglodytes</i>	1	P	No	LC	-
73.	Redwing <i>Turdus iliacus</i>	1	P	No	NT	-
74.	Common blackbird <i>Turdus merula</i>	1	P	No	LC	-
75.	Song thrush <i>Turdus philomelos</i>	1	P	No	LC	-

¹Species protection in Poland: P – protected species, G – game species, PP – partially protected species

²IUCN Species status for Europe: LC – Least concern, VU – Vulnerable, NT – Near Threatened [32]

³HELCOM: VU – Vulnerable, NT – Near Threatened [171]

For the purpose of the assessment of the project impact on migratory birds, some species and categories were summed up at the family level (e.g. geese, gulls, terns) or at the order level (e.g. auks). Pigeons and the common swift were added up to all passerines due to similar migration phenology. Species representing the Anatini tribe were included in the category of dabbling ducks. For further analyses of the migratory fluxes, 21 species and/or categories of the migratory birds recorded in the greatest abundance were taken into consideration [Table 3.8].

Table 3.8. Number of individuals of particular groups of birds as well as spring and autumn migratory species observed during all observation cruises [Source: internal materials]

No.	Species/category	Autumn	Spring	Total	All observations [%]
1.	Geese <i>Anserinae</i>	4804	259	5063	42.94
2.	Passerines/pigeons <i>Passeriformes/Columbinae</i>	1643	715	2358	20.00
3.	Auks <i>Alcidae</i>	495	436	931	7.90
4.	Common scoter <i>Melanitta nigra</i>	53	775	828	7.02
5.	Velvet scoter <i>Melanitta fusca</i>	268	263	531	4.50
6.	Long-tailed duck <i>Clangula hyemalis</i>	203	274	477	4.05
7.	Great black cormorant <i>Phalacrocorax carbo</i>	117	127	244	2.07
8.	Ducks	49	185	234	1.98

No.	Species/category	Autumn	Spring	Total	All observations [%]
	<i>Anatini</i>				
9.	Divers <i>Gaviidae</i>	23	108	131	1.11
10.	Black-headed gull <i>Chroicocephalus ridibundus</i>	19	95	114	0.97
11.	Lesser black-backed gull <i>Larus fuscus</i>	56	57	113	0.96
12.	Common gull <i>Larus canus</i>	59	53	112	0.95
13.	Little gull <i>Hydrocoloeus minutus</i>	17	89	106	0.90
14.	Charadriiformes <i>Charadriidae</i>	14	31	45	0.38
15.	Swans <i>Cygnidae</i>	16	26	42	0.36
16.	Common crane <i>Grus grus</i>	0	34	34	0.29
17.	Greater scaup <i>Aythya marila</i>	14	10	24	0.20
18.	Goosanders <i>Merganser</i> sp.	5	15	20	0.17
19.	Birds of prey/owls <i>Accipitriformes/Strigiformes</i>	8	11	19	0.16
20.	Great black-backed gull <i>Larus marinus</i>	13	1	14	0.12
21.	Terns <i>Sternidae</i>	2	11	13	0.11
22.	Other observations	229	108	337	2.86
Total		8107	3683	11 790	

The most abundant migratory fluxes were determined for passerines including pigeons, auks, sea ducks (the long-tailed duck, the common scoter and the velvet scoter), dabbling ducks, and geese [Table 3.9]. The beginning of the autumn period (August) and the end of the spring period (May) indicated low values of migration fluxes of most birds. The daily migration of terrestrial birds, on the basis of which the migratory fluxes are determined, was particularly intense in October (given the passerines flying in very large numbers). The greatest migratory fluxes for geese (mainly the bean goose and the greylag goose) calculated on the basis of the data collected were recorded for September and October. In spring, the peak of daily migrations of seabirds was observed in April. At that time, the highest migratory fluxes were recorded for the common scoter. Among seagull species, the highest fluxes were recorded in April for the black-headed gull, the little gull and the lesser black-backed gull. Relatively high migratory fluxes were also estimated in March for the little gull and the common gull, while for the lesser black-backed gull – in August and September. In the category of dabbling ducks (mainly the Eurasian wigeon, the common teal and the northern shoveler), migration intensity remained more or less constant throughout the survey, fitting into the general migration pattern: with low abundances at the beginning of the autumn migration and at the end of the spring migration.

Table 3.9. Migratory fluxes of the most frequently observed migratory birds, divided by months and seasons
[Source: internal materials]

Species/categories	Population size [32]	Estimate of migration intensity [number of individuals]	
		Autumn total	Spring total
Passerines and pigeons	100 000 000	129 699	19 228
Common scoter <i>Melanitta nigra</i>	550 000	1551	18 687
Auks <i>Alcidae</i>	>5 000 000	14 235	12 221
Velvet scoter <i>Melanitta fusca</i>	450 000	7190	7543
Long-tailed duck <i>Clangula hyemalis</i>	1 600 000	5958	7085
Ducks (Eurasian wigeon, etc.) <i>Anatini</i>	>6 500 000	6977	6718
Geese <i>Anseridae</i>	>3 500 000	35 197	4509
Great black cormorant <i>Phalacrocorax carbo</i>	515 000	3228	3073
Divers <i>Gaviidae</i>	>400 000	609	3050
Black-headed gull <i>Larus ridibundus</i>	>4 770 000	578	2420
Little gull <i>Hydrocoloeus minutus</i>	>72 000	517	2274
Common gull <i>Larus canus</i>	1 200 000	1727	1478
Lesser black-backed gull <i>Larus fuscus</i>	>1 200 000	1684	1418
Common crane <i>Grus grus</i>	490 000	0	937
Charadriiformes <i>Charadriiformes</i>	>1 600 000	534	833
Swans <i>Cygnus sp.</i>	300 000	304	503
Goosanders <i>Merganser sp.</i>	80 000	213	432
Terns <i>Sternidae</i>	>1 800 000	3240	312
Birds of prey and owls <i>Strigiformes/Strigiformes</i>	>4 600 000	166	289
Greater scaup <i>Aythya marila</i>	310 000	417	234
Great black-backed gull <i>Larus marinus</i>	120 000	378	23
European herring gull <i>Larus argentatus</i>	700 000	0	0
Total		214 402	93 266

The flight altitude analyses conducted in autumn of 2019 using a vertical radar demonstrate that the intensity of migration at night was higher than during the day, practically throughout the entire period of observations, except for the altitudes of up to 250 MASL. At these altitudes, birds were often recorded during daylight hours, especially in October and November. Nocturnal migration (particularly intense in September and October) was most likely dominated by the *Oscine* passerines flying over long distances. As opposed to the other months, in November, a moderately intense yet noticeable migration was recorded at altitudes above 1200 MASL. Visual observations for this period indicated intense migration of passerines, auks and sea ducks, in particular the long-tailed duck. In the spring of 2020, the vertical distribution of bird flight altitudes obtained from the echoes recorded by the vertical radar reflected intense nocturnal migration, especially in April. In March and April, migration during daylight hours (based on visual observations) was dominated by sea ducks (the long-tailed duck and the common scoter), as well as by passerines, such as the common chaffinch, while nocturnal migration was most likely dominated by passerines, especially from the Turdidae family such as the common blackbird and the redwing.

The visual observations conducted demonstrate that the vast majority of the bird groups and species analysed flew at altitudes of up to 20 MASL [Table 3.10]. It should be remembered that the flight altitudes obtained from visual observations represent only a part of all the birds flying 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 MASL. The auxiliary nature of the flight altitude observations should be emphasised, as they are vitiated with an error due to the limited possibilities of bird detection at high altitudes, in favour of birds flying lower and closer to the observers located at the survey station.

Table 3.10. Flight altitude of species and groups of species observed at a distance of up to 20 m and more than 20 m from the water [Source: internal materials]

No.	Species/groups	Below 20 MASL [%]	Above 20 MASL [%]
1.	Auks <i>Alcidae</i>	100.0	0.0
2.	Long-tailed duck <i>Clangula hyemalis</i>	97.9	2.1
3.	Little gull <i>Hydrocoloeus minutus</i>	87.7	12.3
4.	Common scoter <i>Melanitta nigra</i>	87.0	13.0
5.	Greater white-fronted goose <i>Anser albifrons</i>	85.7	14.3
6.	Velvet scoter <i>Melanitta fusca</i>	83.8	16.2
7.	Mallard <i>Anas platyrhynchos</i>	77.8	22.2
8.	Swans <i>Cygnidae</i>	76.2	23.8
9.	Black-headed gull <i>Chroicocephalus ridibundus</i>	75.4	24.6
10.	Great black cormorant <i>Phalacrocorax carbo</i>	74.6	25.4

No.	Species/groups	Below 20 MASL [%]	Above 20 MASL [%]
11.	Greater scaup <i>Aythya marila</i>	66.7	33.3
12.	Eurasian wigeon <i>Mareca penelope</i>	23.8	76.2
13.	Common crane <i>Grus grus</i>	2.9	97.1
14.	Percentage share of all observations	83.6	16.4

On the acoustic recordings collected, 5406 calls of 18 bird species and categories in autumn, and 8890 calls of 23 bird species and categories in spring were identified. Among the passerines, the following species were most commonly identified during night hours: the common blackbird (*Turdus merula*), the redwing (*Turdus iliacus*), the common starling (*Sturnus vulgaris*) and the song thrush (*Turdus philomelos*), while during the daylight hours: the common chaffinch (*Fringilla coelebs*), the great tit (*Parus major*) and the white wagtail (*Motacilla alba*) [Table 3.11]. Among the nocturnal migrants, two species of charadriiformes were also identified – the common snipe and the common sandpiper – as well as the common teal, but in lower, insignificant abundance (between several and around a dozen individuals). During the surveys conducted in August, the calls of gulls were recorded most commonly. These were, most likely, of locally-nesting individuals present in the survey area as a result of short-distance feeding migrations. At the beginning of September, practically only gulls were recorded. It was not until the second half of September that passerines were recorded more frequently, and the highest number of recordings occurred in November. In spring, similarly as in autumn, the calls of gulls dominated. In spring, the vast majority of calls was recorded in the daylight hours (94%).

Table 3.11. Bird calls identified on the basis of recordings made during the autumn migration in August–November 2019 and the spring migration in March–May 2020 [Source: internal materials]

No.	Species/category	Day/Night (time of recording)	Autumn	Spring	Total
1.	Unidentified gull <i>Laridae indet.</i>	D/N	2993	5677	8670
2.	Common chaffinch <i>Fringilla coelebs</i>	D	2	2276	2278
3.	Great tit <i>Parus major</i>	D	666	-	666
4.	European herring gull <i>Larus argentatus</i>	D	87	487	574
5.	Common blackbird <i>Turdus merula</i>	N	383	166	549
6.	White wagtail <i>Motacilla alba</i>	D	496	38	534
7.	Redwing <i>Turdus iliacus</i>	N	239	67	306
8.	Common starling <i>Sturnus vulgaris</i>	N	159	-	159
9.	Song thrush <i>Turdus philomelos</i>	N	138	9	147
10.	European robin <i>Erithacus rubecula</i>	N	114	9	123

No.	Species/category	Day/Night (time of recording)	Autumn	Spring	Total
11.	Goldcrest <i>Regulus regulus</i>	D	90	14	104
12.	Common gull <i>Larus canus</i>	D	2	41	43
13.	Unidentified passerine <i>Passeriformes indet.</i>	D	17	11	28
14.	Eurasian blue tit <i>Parus caeruleus</i>	D	10	11	21
15.	Meadow pipit <i>Anthus pratensis</i>	D/N	-	17	17
16.	Common snipe <i>Gallinago gallinago</i>	N	-	17	17
17.	Black-headed gull <i>Chroicocephalus ridibundus</i>	D/N	-	12	12
18.	Unidentified bird <i>Aves spec.</i>	D/N	-	12	12
19.	Common teal <i>Anas crecca</i>	N	-	9	9
20.	Tree pipit <i>Anthus trivialis</i>	D/N	1	6	7
21.	Western yellow wagtail <i>Motacilla flava</i>	D	3	2	5
22.	Mistle thrush <i>Turdus viscivorus</i>	N	5	-	5
23.	Spotted flycatcher <i>Muscicapa striata</i>	N	-	4	4
24.	Lesser black-backed gull <i>Larus fuscus</i>	D/N	-	3	3
25.	Common sandpiper <i>Actitis hypoleucis</i>	N	-	1	1
26.	Common reed bunting <i>Emberiza schoeniclus</i>	N	-	1	1
27.	Great black-backed gull <i>Larus marinus</i>	N	1	-	1
Total			5406	8890	14 296

Tracking individual birds in flight and recording their flight paths allows the determination of the flight direction during migration of individual species or groups of species. In autumn, a total of 522 flight paths were recorded for 30 species and 10 categories of birds unidentified as to species, whereas in spring, 1609 flight paths were recorded for 51 species and 15 categories of birds unidentified as to species. The analyses carried out using the horizontal radar indicate fairly uniform directions of migratory birds both in spring (N–E direction) and in autumn (W–S direction). Some of the groups and bird species subject to tracking flew in the direction opposite to the main direction of migration. This situation was observed for gulls, auks and divers, which may be due to the fact that not all radar-tracked birds belonging to those groups were migrating at the time. In the case of auks and divers, it is possible that some birds had already completed their migration and the paths referred to birds moving locally within the wintering area. In the case of gulls, it is likely that the paths were recorded for local gulls, which remained in the Baltic Coastal Waters Area all year round.

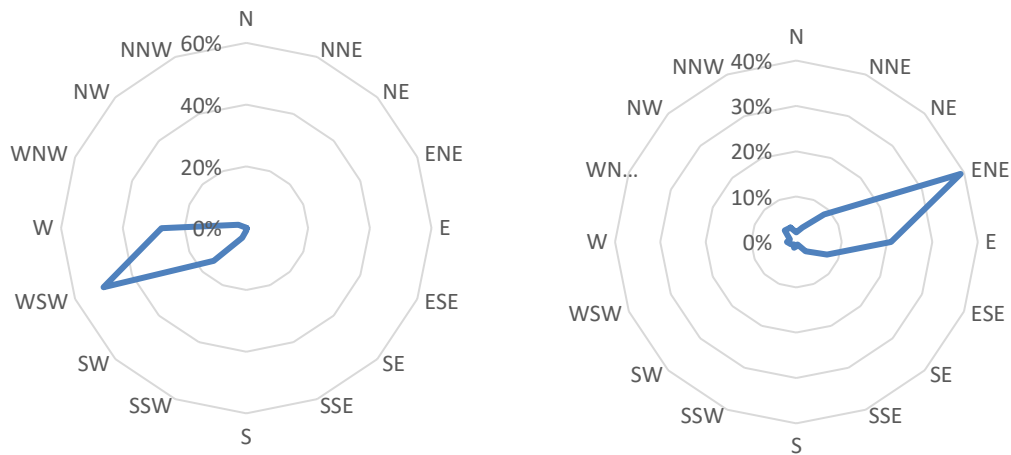


Figure 3.15. Flight directions of all the bird species recorded during the autumn migration in August–November 2019 (left) and the spring migration in March–May 2020 (right) [Source: internal materials]

For further analyses for the purposes of the modelling of collision risk and the barrier effect of the environmental impact assessment, species were selected according to the abundance criterion – number of observations (the most commonly observed species and groups of species were included), as well as according to the criterion of expert knowledge on the species usually migrating across the Baltic Sea area and observed sparsely during surveys (e.g. the common crane). The information on the species protection status and the importance of the species as a receptor according to the methodology adopted in the EIA Report were also taken into consideration. This information along with the size of biogeographic populations and the assessment of the resource importance are presented in Table 3.12. The above information was the basis for the significance assessment of the BC-Wind OWF impact on migratory birds.

Table 3.12. Species and groups of species included in the analyses for the purposes of this report with the assessment of the significance of vulnerable populations [Source: internal materials]

Taxon/category	Biogeographical population of birds influenced by potential impacts of the OWF	Migration season	Estimate of migration intensity [No. of individuals]	Share of the population of birds in flight [%]	Significance of vulnerable population	Size of vulnerable population	Receptor value/significance
Long-tailed duck <i>Clangula hyemalis</i>	1 600 000	Spring	7085	0.44	Moderate	Local	High
		Autumn	5958	0.37	Irrelevant	Irrelevant	
Common scoter <i>Melanitta nigra</i>	550 000	Spring	18 687	3.40	High	Regional	Moderate
		Autumn	1551	0.28	Irrelevant	Irrelevant	
Velvet scoter <i>Melanitta fusca</i>	450 000	Spring	7543	1.68	Irrelevant	Irrelevant	High
		Autumn	7190	1.60	Moderate	Local	
Ducks (Eurasian wigeon, etc.) <i>Anatini</i>	6 500 000	Spring	6718	0.10	Irrelevant	Irrelevant	Low
		Autumn	6977	0.11	Irrelevant	Irrelevant	
Greater scaup <i>Aythya marila</i>	310 000	Spring	234	0.08	Moderate	Local	Low
		Autumn	417	0.13	Irrelevant	Irrelevant	
Geese <i>Anseridae</i>	3 500 000	Spring	4509	0.13	Irrelevant	Irrelevant	Low
		Autumn	35 197	1.01	Moderate	Local	
Swans <i>Cygnus sp.</i>	300 000	Spring	503	0.17	Irrelevant	Irrelevant	Low
		Autumn	304	0.10	Irrelevant	Irrelevant	
Divers <i>Gaviidae</i>	400 000	Spring	3050	0.76	Irrelevant	Irrelevant	Low
		Autumn	609	0.15	Irrelevant	Irrelevant	
Auks <i>Alcidae</i>	5 000 000	Spring	12 221	0.24	Irrelevant	Irrelevant	Low
		Autumn	14 235	0.28	Irrelevant	Irrelevant	
	515 000	Spring	3073	0.60	Irrelevant	Irrelevant	Low

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Taxon/category	Biogeographical population of birds influenced by potential impacts of the OWF	Migration season	Estimate of migration intensity [No. of individuals]	Share of the population of birds in flight [%]	Significance of vulnerable population	Size of vulnerable population	Receptor value/significance
Great black cormorant <i>Phalacrocorax carbo</i>		Autumn	3228	0.63	Irrelevant	Irrelevant	
Little gull <i>Hydrocoloeus minutus</i>	72 000	Spring	2274	3.16	Very high	Global	Moderate
		Autumn	517	0.72	Irrelevant	Irrelevant	
Lesser black-backed gull <i>Larus fuscus</i>	1 200 000	Spring	1418	0.12	Irrelevant	Irrelevant	Low
		Autumn	1684	0.14	Irrelevant	Irrelevant	
Common gull <i>Larus canus</i>	1 200 000	Spring	1478	0.12	Irrelevant	Irrelevant	Low
		Autumn	1727	0.14	Irrelevant	Irrelevant	
Terns <i>Sternidae</i>	1 800 000	Spring	312	0.02	Irrelevant	Irrelevant	Low
		Autumn	3240	0.18	Irrelevant	Irrelevant	
Charadriiformes <i>Charadriiformes</i>	1 600 000	Spring	833	0.05	Irrelevant	Irrelevant	Low
		Autumn	534	0.03	Irrelevant	Irrelevant	
Common crane <i>Grus grus</i>	490 000	Spring	937	0.39	Irrelevant	Irrelevant	High
		Autumn	0	0.00	None	None	
Passerines Passeriformes	100 000 000	Spring	19 228	0.02	Irrelevant	Irrelevant	Low
		Autumn	129 699	0.13	Irrelevant	Irrelevant	

3.7.1.6 Seabirds

Seabird observations were conducted in the BC-Wind 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 September 2019 to August 2020. Detailed survey results for these areas were included in the report on the seabird inventory results which constitutes 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 BC-Wind OWF Area

During the observations conducted in the BC-Wind OWF Area (2 NM), a total of 16 bird species staying in the sea area were recorded, including 12 species connected to the marine environment and 4 species of water birds rarely encountered at sea away from the coast [Table 3.13, Figure 3.16].

Table 3.13. Abundance and percentage share in the group of individual bird species sitting on the water, found in the BC-Wind OWF Area (2 NM) along the cruise route in the entire period from September 2019 to August 2020 [Source: internal materials]

Species	Number of individuals observed [ind.]	Share in the group [%]
Seabirds		
European herring gull <i>Larus argentatus</i>	1331	57.3
Razorbill <i>Alca torda</i>	280	12.1
Common guillemot <i>Uria aalge</i>	237	10.2
Long-tailed duck <i>Clangula hyemalis</i>	210	9.0
Great black-backed gull <i>Larus marinus</i>	33	1.4
Little gull <i>Hydrocoloeus minutus</i>	30	1.3
Lesser black-backed gull <i>Larus fuscus</i>	25	1.1
Common scoter <i>Melanitta nigra</i>	9	0.4
Black-throated diver <i>Gavia arctica</i>	3	0.1
Velvet scoter <i>Melanitta fusca</i>	2	0.1
Black guillemot <i>Cephus grylle</i>	2	0.1
Red-throated diver <i>Gavia stellata</i>	1	+
Waterbirds rarely encountered at sea away from the coast		
Common gull <i>Larus canus</i>	10	0.4

Species	Number of individuals observed [ind.]	Share in the group [%]
Greylag goose <i>Anser anser</i>	6	0.3
Great black cormorant <i>Phalacrocorax carbo</i>	3	0.1
Eurasian wigeon <i>Anas penelope</i>	2	0.1
Birds unidentified as to species		
Razorbill or a common guillemot <i>Alca torda/Uria aalge</i>	133	5.7
Unidentified specimen of gaviiformes <i>Gavia sp.</i>	6	0.3
Total	2323	100

+ – percentage share smaller than 0.1%

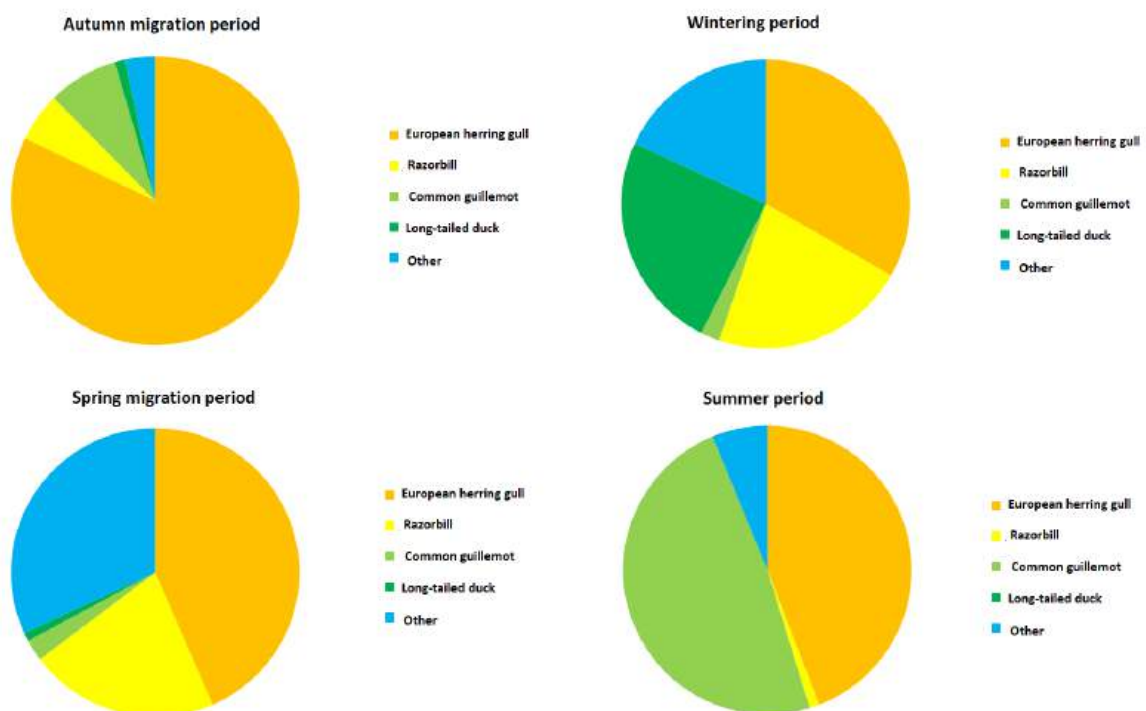


Figure 3.16. Share of the prevailing species of birds sitting on the water in the entire group of birds in the BC-Wind OWF Area (2 NM) within the entire period from September 2019 to August 2020 [Source: internal materials]

In total, 2323 individuals of seabirds were observed along the transects in the BC-Wind OWF Area (2 NM). The category of “water birds rarely encountered at sea away from the coast” includes 4 species (the common gull, the great black cormorant, the greylag goose, and the Eurasian wigeon). 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 [80] and react in a similar way to offshore wind farms located in the maritime areas [79].

Within the sea area intended for the construction of the BC-Wind OWF, the average densities of seabirds were very low and only during the wintering period they exceeded the value of 10 ind.·km⁻² in a greater part of the area (density maps included in Appendix 1 to the EIA Report). The most

abundant species was the European herring gull whose occurrence in sea areas far away from the coast are related to the operation of fishing boats. The low abundance of birds in the OWF Area is due to significant depths of the sea, which makes feeding difficult for the most numerous groups of diving benthivorous birds wintering in the Baltic Sea, such as the long-tailed duck and velvet scoter. Compared to the additional areas belonging to the Natura 2000 network, the razorbills and the common guillemots were abundant in the BC-Wind OWF Area. These are piscivorous species and their occurrence is not significantly affected by the depth of the sea area. It can be assumed that they found an abundant food supply there.

In the BC-Wind OWF Area, the presence of 13 bird species under strict protection in Poland (razorbill, common guillemot, long-tailed duck, great black-backed gull, little gull, lesser black-backed gull, common scoter, black-throated diver, velvet scoter, black guillemot, red-throated diver, common gull, Eurasian wigeon) and two species under partial protection (European herring gull and great black cormorant) 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. Two of the species observed (the long-tailed duck, the velvet scoter) 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, 24 species of birds staying in the sea area were recorded, including 15 species connected to the marine environment and 9 species of waterbirds rarely encountered at sea away from the coast, i.e. the common gull, the great black cormorant, the mute swan, the great crested grebe, the black-headed gull, the great white-fronted goose, the red-breasted merganser, the common teal, and the goosander [Table 3.14].

Table 3.14. 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 period from September 2019 to August 2020 [Source: internal materials]

Species	Number of individuals observed [ind.]	Share in the group [%]
Seabirds		
Long-tailed duck <i>Clangula hyemalis</i>	63 218	69.6
Velvet scoter <i>Melanitta fusca</i>	23 334	25.7
European herring gull <i>Larus argentatus</i>	1865	2.1
Razorbill <i>Alca torda</i>	1079	1.2
Common scoter <i>Melanitta nigra</i>	345	0.4

Species	Number of individuals observed [ind.]	Share in the group [%]
Common guillemot <i>Uria aalge</i>	264	0.3
Black-throated diver <i>Gavia arctica</i>	66	0.1
Black guillemot <i>Cephus grylle</i>	65	0.1
Little gull <i>Hydrocoloeus minutus</i>	46	0.1
Great black-backed gull <i>Larus marinus</i>	33	+
Lesser black-backed gull <i>Larus fuscus</i>	30	+
Red-throated diver <i>Gavia stellata</i>	18	+
Common eider <i>Somateria mollissima</i>	3	+
Horned grebe <i>Podiceps auritus</i>	1	+
Great skua <i>Catharacta skua</i>	1	+
Waterbirds rarely encountered at sea away from the coast	197	0.2
Birds unidentified as to species	259	0.3
Total	90 824	100

+ – percentage share smaller than 0.1%

The detailed results of seabird surveys conducted in the BC-Wind 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 BC-Wind 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 velvet scoter, the razorbill, the common guillemot, the common scoter, and the European herring gull. The species, which did not meet the above-mentioned condition, but which is subject to protection in the nearest Natura 2000 sites, is the black guillemot. It 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. As a result, the

black guillemot was included in the assessment only in the context of the OWF impact on the Natura 2000 sites.

The assessment did not include the birds subject to protection in the neighbouring Natura 2000 sites, for which the “population” parameter in SDF reached the “D” (irrelevant) category, i.e. the black-throated and the red-throated diver as well as the common gull.

3.7.1.7 Bats

The surveys which involved ringing and direct observations showed 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 [183]. Long-distance migration flights have also been detected recently by measuring stable isotopes in the common noctule, particularly in northern Europe [247]. The mentioned species migrating over long distances migrate also across the Baltic Sea in spring and autumn [410].

Many of the bat migration surveys were conducted in Scandinavia, and these show that migrating bats gather at particular outlets along the southern coast of Sweden and then depart individually or in small groups to their wintering habitats in the Central and Western Europe [3]. Large concentrations of the Nathusius’ pipistrelle during the migration period has been recorded, for example, on the west coast of Finland [186]. It is assumed that migratory bats depart from the assembly points and fly along corridors which widen strongly as the distance from the outlets increases in the south-south-western direction [404]. Moreover, it is assumed that bats migrate along characteristic landscape features, such as the coastline. Therefore, the entire Baltic Sea coastline, as well as its islands are of great significance to the migration of bats [396].

Each year, more than 250 000 bats get killed as a result of collisions with the onshore wind turbines in Germany, of which more than 70% of the bats killed are migratory species [484]. Comparative mortality results for the offshore wind farms are not available, since mortality at sea cannot be estimated using the conventional monitoring methods. However, it is assumed that the risk of collision with offshore wind farms may be increased, especially during migratory periods (spring and autumn) [371]. The current volume of data on the bat activity on the coast and at sea is small; however, the habitats connected to the sea may be especially significant for the bats migrating over large distances [73].

The statistics for the common noctule, as well as the Nathusius’s pipistrelle show a very high risk of mortality connected to wind turbines. The very high risk of mortality is connected to the specific flight behaviours of those two species. These open-space foraging species – they fly fast and high with limited agility. As stems from the available sources, the mortality of the common noctule as a result of collisions with the elements of wind farms is the highest compared to other bat species [210, 211]. The data relate to European onshore wind farms. So far, no similar studies have been conducted for OWFs. The Nathusius’ pipistrelle is in this context the second most vulnerable species [210, 211].

Unlike the Nathusius’ pipistrelle and the common pipistrelle, the soprano pipistrelle hunts at lower altitudes, flying fast, but rather agilely. Therefore, the risk of the soprano pipistrelle mortality as a result of collisions with wind turbines is relatively lower, although according to Kepel *et al.* [210, 211] this is still a high mortality risk.

Table 3.15 shows the expected mortality risk at wind farms for the species recorded during the surveys conducted in compliance with the guidelines [210, 211] in the BC-Wind OWF Area. The species included in the Nyctaloid group are also listed in Table 3.15. It should be noted that data in the fourth and fifth columns of Table 3.15 concern mainly wind farms.

Table 3.15. Bat species recorded and their mortality risk at wind farms according to Kepel *et al.* [211]

Species		Conservation status (IUCN Red Data Book)*	Mortality recorded in Europe	Risk of death at wind farms
Name of species	Binomial nomenclature			
Common noctule	<i>Nyctalus noctula</i>	LC	+++	Very high
Lesser noctule	<i>Nyctalus leiseri</i>	LC	+++	Very high
Common noctule	<i>Nyctalus lasiopterus</i>	VU	++	Very high
Northern bat	<i>Eptesicus nilssonii</i>	LC	++	Moderate
Serotine bat	<i>Eptesicus serotinus</i>	LC	+++	Moderate
Parti-coloured bat	<i>Vespertilio murinus</i>	LC	++	Moderate
Nathusius' pipistrelle	<i>Pipistrellus nathusii</i>	LC	+++	Very high
Soprano pipistrelle	<i>Pipistrellus pygmaeus</i>	LC	+++	High

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

IUCN Red Data Book categories (DIETZ *et al.* 2016): EN – endangered, VU – vulnerable, NT – near-threatened, DD – data deficient, LC – least concern

In Poland, there are no legal regulations concerning the bat survey methodology in the context of wind energy. Therefore, in the bat surveys conducted in the BC-Wind OWF Area, the survey methods based on the guidelines by Kepel *et al.* [210, 211] as well as the EUROBATs specification [371] were used. The methods applied are compliant with the specifications mentioned, although some adjustments were made, since the guidelines were developed for onshore wind farms. Since the bat surveys conducted relate to OWFs, the survey periods were limited to the spring and autumn migration seasons.

The surveys on bat activity in the BC-Wind OWF Area were conducted from August to October 2019 (autumn migration) and from April to May 2020 (spring migration). The recording of acoustic signals was conducted during surveys from aboard a vessel, which sailed along the designated transect route with a total length of approx. 55 km and at two monitoring stations. The registrations by the monitoring stations were carried out from aboard an anchored vessel.

During the autumn migration surveys, in the BC-Wind OWF Area, bat activity was recorded at a single monitoring station and along the transect route. The call sequences were assigned to the following species: the common noctule, the Nathusius' pipistrelle, and the soprano pipistrelle, as well as to the Nyctaloid group species (*Nyctalus* sp, *Vespertilio* spp. and *Eptesicus* groups, species with similar sonograms which cannot be conclusively identified to the species level).

During the autumn migration surveys, the dominant bat species in the BC-Wind OWF Area was the common noctule. Most of the bat activity units which were assigned to the common noctule, were recorded during the August campaign. The second most commonly detected species during the autumn campaign was the Nathusius' pipistrelle (twelve activity units); whereas, in the case of the soprano pipistrelle, only a single activity unit was recorded.

The average activity indices for the *Pipistrellus* spp., *Nyctalus* spp. and the Nyctaloid group species as well as for all bats, calculated for the autumn migration in accordance with the method applied [210,

211], were within category A (low bat activity). In the case of activity category A, no preventive nor mitigating measures are required. At one of the monitoring stations, the average activity index calculated for a single group of species (*Nyctalus* spp.) as well as for all bats was assigned category B (moderate bat activity). In accordance with the guidelines [210, 211], also in the case of moderate activity, no preventive or mitigating measures are required, if the activity index of category B is present within a single period, at individual sections or points. This applies to the results of the monitoring surveys conducted.

During the spring migration surveys – from April to May 2019 – bat activity was recorded at one out of two monitoring stations and along a single transect. No bat activity was recorded at the remaining stations. The bat activity recorded was assigned to the Nathusius' pipistrelle and common noctule species as well as the *Nyctaloid* group. The bat activity indices calculated, as well as the average bat activity indices [210, 211] belonged to category A (low activity).

During the entire autumn and spring migration periods, three bat species were recorded (the common noctule, the Nathusius' pipistrelle, and the soprano pipistrelle). Two of those species, the Nathusius' pipistrelle and the common noctule, belong to the species migrating over large distances. They are widely distributed across the European continent and use habitats located in the north-western part of Europe, whereas hibernate in the south-western part of the continent. 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 [3]. 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 [210, 3]. Unlike the two species mentioned above, the soprano pipistrelle is not classified as a migratory species. However, it has been recorded in the OWF areas [3].

The activity indices calculated for different bat species for the entire autumn and spring migration periods, demonstrate **low bat activity within the BC-Wind OWF Area surveyed**. In compliance with the guidelines [210, 211], during the implementation of the planned OWF, no preventive or mitigating measures are required.

At the same time, it cannot be excluded that migrating bats will fly across the BC-Wind OWF Area. However, the bat activity levels recorded within the entire survey period provide no indication of bat migration within the OWF Area.

3.7.2 Protected areas including Natura 2000 sites

The BC-Wind 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 BC-Wind 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. 63 km away from the BC-Wind OWF Area, a Swedish Natura 2000 site Hoburgs bank och Midsjöbankarna (SE0330308) is situated.

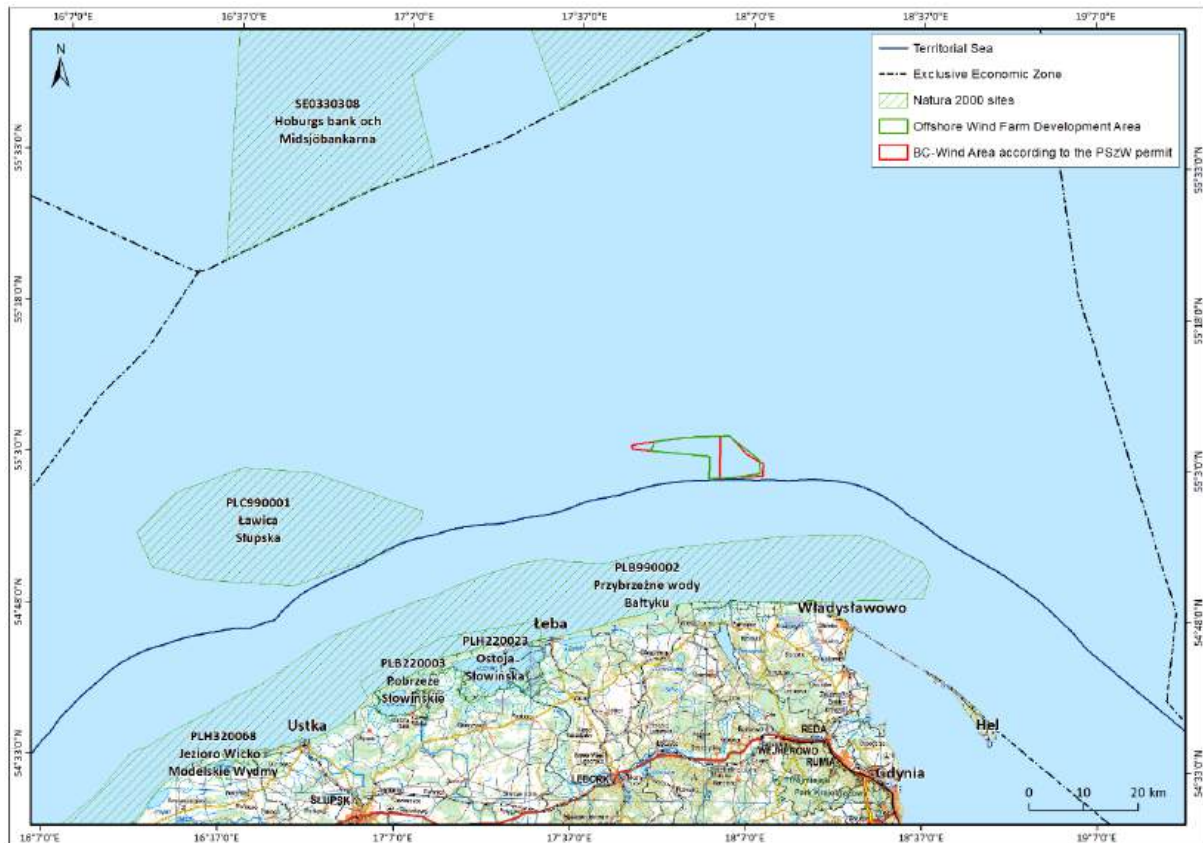


Figure 3.17. Location of the European Ecological Network Natura 2000 sites and the BC-Wind OWF Area [Source: internal materials]

Przybrzeżne Wody Bałtyku site (PLB990002)

The protected area nearest to the BC-Wind OWF Area is the Przybrzeżne wody Bałtyku site (PLB990002). The distance between those areas is approx. 12 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 BC-Wind 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 [139]. 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.

Table 3.16. Basic information on seabirds in the Przybrzeżne wody Bałtyku site (PLB990002) [Source: internal materials based on the SDF Przybrzeżne wody Bałtyku (2021)]

Species	Population type	Assessment of the area for the population*	Population size in the area [number of individuals]		Percentage of the migratory population
			Minimum	Maximum	
Black-throated diver <i>Gavia arctica</i>	Wintering	D	200	500	Below 1%
Red-throated diver <i>Gavia stellata</i>	Wintering	D	100	500	Below 1%
European herring gull <i>Larus argentatus</i>	Wintering	C	8000	15 000	Below 1%
Common gull <i>Larus canus</i>	Wintering	D	1000	1000	Below 1%
Black guillemot <i>Cepphus grylle</i>	Wintering	B	1500	1500	At least 1%
Razorbill <i>Alca torda</i>	Wintering	C	500	1000	Below 1%
Long-tailed duck <i>Clangula hyemalis</i>	Wintering	B	90 000**	120 000**	Above 1%
Velvet scoter <i>Melanitta fusca</i>	Wintering	C	14 000**	20 000**	At least 1%
Common scoter <i>Melanitta nigra</i>	Wintering	C	5000	8000	Below 1%
	Passing	C	3000	3000	Below 1%

*Estimation of the species population size and density in relation to the national population; class ranges: A: $100 \geq p > 15\%$, B: $15 \geq p > 2\%$, C: $2 \geq p > 0\%$; 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 BC-Wind OWF Development Area is located at a distance of approx. 43 km from the Słupsk Bank site (PLC990001) designated as part of 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 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 inhabited 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 fucoidea* [231]. 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. 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).

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 contour [120]. In the Słupsk Bank site, mainly sandy-gravelly 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, 221, 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 [11, 316].

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 <i>Cephus grylle</i>	Wintering	C	400**	1000**	At least 1%
Long-tailed duck <i>Clangula hyemalis</i>	Wintering	B	25 000**	32 000**	At least 1%
Black-throated diver <i>Gavia arctica</i>	Wintering	D	-	-	Below 1%
Red-throated diver <i>Gavia stellata</i>	Wintering	D	140	140	Below 1%

*Class ranges: A: $100 \geq p > 15\%$, B: $15 \geq p > 2\%$, C: $2 \geq p > 0\%$; 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://datazone.birdlife.org/site/factsheet/slupsk-bank-iba-poland/details>; accessed on: 16/04/2021) containing data provided in the SDF form

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

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 habitat	Name of 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

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

²Class ranges: A: $100 \geq p > 15\%$, B: $15 \geq p > 2\%$, C: $2 \geq p > 0\%$

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

⁴Classification 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 offshore boundary is located approx. 37 km away from the BC-Wind 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 offshore area of the Ostoja Słowińska site (PLH220023) is a habitat for two species of marine mammals and five species of fish and lampreys connected to the marine environment [Table 3.19]. In the western part of this area there is a boulder area constituting a natural habitat 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 <i>Halichoerus grypus</i>	Migrating	C	B	B	B
Harbour porpoise <i>Phocoena phocoena</i>	Migrating	B	B	B	B
Twaite shad <i>Alosa fallax</i>	Migrating	C	B	C	C
River lamprey <i>Lampetra fluviatilis</i>	Migrating	B	B	C	B
Sabrefish <i>Pelecus cultratus</i>	Resident	C	B	C	C
Sea lamprey <i>Petromyzon marinus</i>	Migrating	C	B	C	B
Atlantic salmon <i>Salmo salar</i>	Migrating	D	-	-	-

¹The estimation of the size of the species population and its density in relation to the national population; class ranges: A: $100 \geq p > 15\%$, B: $15 \geq p > 2\%$, C: $2 \geq p > 0\%$; area assessment for population D (species which are not the subject of protection in the area)

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

³Classification 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

⁴Classification 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 ²	Conservation status ³	General assessment ⁴
1170	Reefs	402.06	B	C	A	B

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

²Class ranges: A: $100 \geq p > 15\%$, B: $15 \geq p > 2\%$, C: $2 \geq p > 0\%$

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

⁴Classification scheme for the 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 BC-Wind 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 the seabirds in the Pobreże Słowińskie site (PLB220003) [Source: internal materials based on the SDF Pobreże Słowińskie (2021)]

Species	Population type	Assessment of the area for the population*	Population size in the area [number of individuals]	
			Minimum	Maximum
Tengmalm's owl <i>Aegolius funereus</i>	Resident	D	1	1
Eurasian wigeon <i>Anas penelope</i>	Passing	D	-	-
Mallard <i>Anas platyrhynchos</i>	Passing	D	-	-
Greater white-fronted goose <i>Anser albifrons</i>	Passing	C	1000	6200
Bean goose <i>sensu lato</i> <i>Anser fabalis</i>	Passing	A	3200	4500
Golden eagle <i>Aquila chrysaetos</i>	Breeding	B	1	1
Lesser spotted eagle <i>Aquila pomarina</i>	Breeding	D	1	1
Short-eared owl <i>Asio flammeus</i>	Passing	D	1	2
Common pochard <i>Aythya ferina</i>	Passing	C	1	1500
Eurasian bitter <i>Botaurus stellaris</i>	Breeding	D	2	4
Eurasian eagle-owl <i>Bubo bubo</i>	Resident	B	5	5
Dunlin <i>Calidris alpina</i>	Breeding	D	-	-
	Passing	D	140	140
European nightjar <i>Caprimulgus europaeus</i>	Breeding	D	30	30
Common ringed plover <i>Charadrius hiaticula</i>	Breeding	C	10	10
White stork <i>Ciconia ciconia</i>	Breeding	D	15	25
Black stork <i>Ciconia nigra</i>	Breeding	D	1	1
Western marsh harrier <i>Circus aeruginosus</i>	Breeding	D	7	9
Hen harrier <i>Circus cyaneus</i>	Breeding	D	-	-

Species	Population type	Assessment of the area for the population*	Population size in the area [number of individuals]	
			Minimum	Maximum
Montagu's harrier <i>Circus pygargus</i>	Breeding	D	4	5
Corn crane <i>Crex crex</i>	Breeding	C	200	250
Whooper swan <i>Cygnus cygnus</i>	Passing	B	560	560
Common crane <i>Grus grus</i>	Passing	C	7000	7000
White-tailed eagle <i>Haliaeetus albicilla</i>	Breeding	D	4	4
	Passing	D	10	30
European herring gull <i>Larus argentatus</i>	Breeding	B	400	400
Lesser black-backed gull <i>Larus fuscus</i>	Breeding	D	2	2
Smew <i>Mergus albellus</i>	Passing	B	1700	1700
Goosander <i>Mergus merganser</i>	Passing	C	1	2100
Black kite <i>Milvus migrans</i>	Breeding	D	1	1
Red kite <i>Milvus milvus</i>	Breeding	C	7	8
Osprey <i>Pandion haliaetus</i>	Breeding	D	1	1
European honey buzzard <i>Pernis apivorus</i>	Breeding	D	1	1
Great cormorant <i>Phalacrocorax carbo sinensis</i>	Breeding	C	200	200
Ruff <i>Philomachus pugnax</i>	Passing	D	380	380
Spotted crane <i>Porzana porzana</i>	Breeding	D	1	4
Little tern <i>Sterna albifrons</i>	Breeding	D	1	3
Common tern <i>Sterna hirundo</i>	Breeding	D	1	15

*Estimation of the species population size and density in relation to the national population; class ranges: A: $100 \geq p > 15\%$, B: $15 \geq p > 2\%$, C: $2 \geq p > 0\%$; 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 land and sea national parks in Poland. Its 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. 63 km away from the BC-Wind 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

¹The classification system of representativeness assessment: A: excellent, B: good, C: significant, D: negligible representativeness

²Class ranges: A: $100 \geq p > 15\%$, B: $15 \geq p > 2\%$, C: $2 \geq p > 0\%$

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

⁴The classification system of 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	
			Minimum	Maximum
Black guillemot <i>Cephus grylle</i>	Wintering	C	1000	5000
Long-tailed duck <i>Clangula hyemalis</i>	Wintering	A	200 000	1 000 000
Common eider <i>Somateria mollissima</i>	Migrating	C	5000	50 000

*Estimation of the species population size and density in relation to the national population; class ranges: A: $100 \geq p > 15\%$, B: $15 \geq p > 2\%$, C: $2 \geq p > 0\%$; 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 <i>Phocoena phocoena</i>	Migrating	C	B	B	B

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

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

³Classification 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

⁴Classification 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 [194], however, no wildlife corridors for the PMA were indicated therein.

According to the general classification of the migration system of aquatic and wetland birds in Eurasia, Poland, including its marine areas, is located within the two large flyways: the East Atlantic and the Mediterranean/Black Sea flyways. The migration tactics, as well as the 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. A series of water bird species can be observed within the PMA already since August. 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 [407].

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

No phytobenthos has been found in the BC-Wind OWF Area.

3.7.4.2 Macrozoobenthos

In the BC-Wind OWF Area (1 NM), on the soft bottom (sandy, gravelly sediments), 21 taxa (species and higher taxonomic units unidentified as to the species) belonging to the phyla Nemertea and Priapulida and to 6 divisions: Hydrozoa, Polychaeta, Clitellata, Malacostraca, Bivalvia and Gymnolaemata were found. The absolutely constant taxa were the three species of polychaetes *Pygospio elegans*, *Marenzelleria* sp. and *Bylgides sarsi*, one species of bivalves – *Limecola balthica* and a representative of the malacostracans – *Diastylis rathkei*. In terms of abundance, this type of seabed was dominated by the psammophilous polychaet *Pygospio elegans*, common in the PMA, while the greatest share in the biomass had the Baltic clam *Limecola balthica*, characterised by a wide range of tolerance to environmental factors (Appendix 1 to the EIA Report).

On the hard bottom (stone surfaces), among the periphytic and phytophilic fauna, 17 taxa were found belonging to 7 divisions: Hydrozoa, Clitellata, Polychaeta, Hexanauplia, Malacostraca, Bivalvia and Gymnolaemata. The most common taxa were: the polychaete *Bylgides sarsi*, the bivalves *Mytilus trossulus*, *Einhornia crustulenta* (bryozoans), *Gonothyraea loveni* (hydrozoan) and the crustacean *Jaera* (*Jaera*) *albifrons*. However, in the domination structure of abundance and biomass, the bay mussel *Mytilus trossulus* forming aggregations consisting of a dozen individuals, being an important nutrient

for fish and birds and playing an important habitat-forming role in the environment definitely prevailed (Appendix 1 to the EIA Report).

The taxa identified are the representatives of the invertebrate macrofauna typical and commonly occurring in the open waters of the Southern Baltic. The taxonomic composition, abundance and biomass of macrozoobenthos in both habitats (soft and hard bottom) of the BC-Wind OWF were typical of the medium-deep seabed of the Eastern Gotland Basin (up to 60 MBSL) [144; Appendix 1 to the EIA Report], however, they did not stand out in terms of taxonomic diversity. In comparison to the results of the macrozoobenthos surveys conducted in the adjacent planned project areas such as the Bałtyk III and Bałtyk II OWFs [153, 154] as well as the Baltica 2 and Baltica 3 OWFs [25], the results of the qualitative structure of the macrozoobenthos community in the BC-Wind OWF Area are slightly poorer.

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 [443]. The fish species prevailing in the deeper waters of the western Baltic Sea are cod and flounder in the demersal zone as well as herring and sprat in the pelagic zone [16, 214, 178].

According to CIEP, 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 21 fish species were observed in the BC-Wind OWF Area during the surveys.

In the case of ichthyoplankton, the roe of a single fish species and larvae belonging to 10 taxa were caught. Throughout the entire survey period, sprat represented the most significant proportion in the total larval abundance (82.9%) of all species, followed by gobies (8.7%) and flounder (4.8%). The larvae of the remaining 7 species, such as common sea snail, herring, ammodytids, fourbeard rockling, longspined bullhead, rock gunnel and cod were significantly less numerous (from 0.12 to 1.2%).

During pelagic catches, 9 species of fish were caught, 99% of which were sprat and herring. The presence of single specimens of garfish, three-spined stickleback, great sand eel, anchovy, flounder, lesser sand eel and cod was confirmed.

During demersal fish catches, fish belonging to 13 taxa were recorded. Flounder and cod dominated, whereas other species were a small by-catch (great sand eel, plaice, shorthorn sculpin, pogge, mackerel, fourbeard rockling, turbot, herring, sprat, lumpfish, viviparous eelpout).

3.7.4.4 Marine mammals

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

3.7.4.5 Seabirds

The species diversity of seabird communities observed in the BC-Wind OWF Area varied depending on the season, in which the observations were conducted [Table 3.25].

During the autumn migration period, the presence of 9 seabird species was confirmed in the OWF Area. The most numerous of the species was definitely the European herring gull constituting 82.1% of all the birds confirmed. Three other species had a share exceeding 1% in the grouping, namely: the common guillemot (7.9%), the razorbill (5.5%), and the long-tailed duck (1.2%). The remaining species were not abundant, and their total abundance recorded during all inspections did not exceed 1% (the lesser black-backed gull 0.8%, the little gull 0.3%, the great black-backed gull 0.3%, the velvet scoter 0.2% and the black guillemot 0.1%).

In winter, the presence of a smaller number of species was recorded in comparison to the autumn migration period, i.e. 7 species. The most abundant species recorded in that sea area were the European herring gull (33.3% of the entire bird grouping), the long-tailed duck (24.5%) and the razorbill (22.0%). A share exceeding 1% was also recorded for the great black-backed gull (3.6%) and the common guillemot (2.1%). The remaining species, whose total abundance did not exceed 1%, were: the little gull 0.3% and the black guillemot 0.1%.

During the spring migration period, the presence of 9 species was confirmed in the OWF Area. The most numerous of the species was the European herring gull constituting 43.5% of all the birds confirmed and the razorbill constituting 21.3%. A share of almost 1% in the entire bird grouping was achieved by 6 more species: the little gull (11.6%), the lesser black-backed gull (4.3%), the common scoter (4.3%), the common guillemot (2.4%), the black-throated diver (1.4%) and the long-tailed duck (1.0%).

The least abundant species in that period was the red-throated diver (0.5%). In the summer period, the presence of 6 seabird species was recorded in the BC-Wind OWF Area. The common guillemot (48.5%) and the European herring gull (44.2%) were the most abundant. A share exceeding 1% was also recorded for the lesser black-backed gull (2.2%) and the razorbill (1.1%). The least abundant species were: the little gull and the great black-backed gull (0.4% each).

Table 3.25. Number of species and the most numerous seabird species observed in the BC-Wind OWF Area in individual phenological periods [Source: internal materials]

Parameter	Autumn migration period	Wintering period	Spring migration period	Summer period
Number of species	9	7	9	6
Most abundant species	European herring gull, common guillemot, razorbill, long-tailed duck	European herring gull, long-tailed duck, razorbill, great black-backed gull, common guillemot	European herring gull, razorbill, little gull, lesser black-backed gull, common scoter, common guillemot, black-throated diver, long-tailed duck	Common guillemot, European herring gull, lesser black-backed gull, razorbill

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 BC-Wind OWF Area, which can be used for its valorisation, is the depth of the sea area. It changes from 27.6 m in the southern part of the area to 65.2 m in its north-eastern part. As a result, in winter, the shallowest, southern section of the BC-Wind 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 BC-Wind 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 values, monuments and archaeological sites and objects

During geophysical surveys conducted in 2020 in the BC-Wind OWF Area, the presence of 6 shipwrecks, including 2, which had been previously identified and 4 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 Gdynia 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 in the case that these wrecks will be provided with special protection in places where they are located and in the direct protection zones, the work related to the construction and operation of the BC-Wind OWF will not be carried out.

3.9 Use and development of the sea area and the material goods

3.9.1 Navigation

The BC-Wind OWF Area is characterised by a moderate degree of use for the purposes of navigation [Figure 3.18].

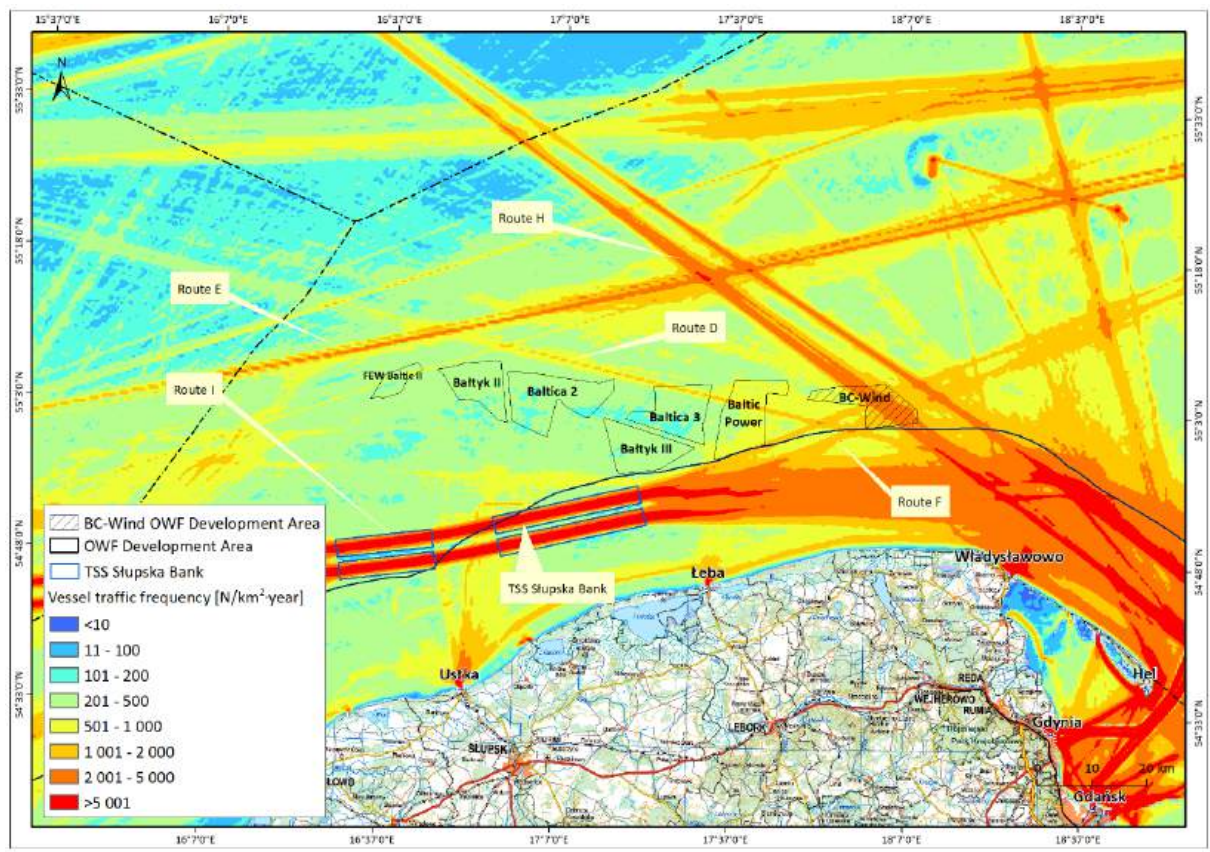


Figure 3.18. Shipping routes around the BC-Wind OWF Area, red – sections of routes, the possible modification of which requires international agreements and an approval by the IMO [Source: internal materials based on AIS data]

Currently, a regular shipping route runs across the BC-Wind 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 [517]. The AIS data demonstrate that in the years 2018–2019 vessels travelled more than 1000 times annually across the OWF Area using this route. 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 Maritime Spatial Plan of Polish Sea Areas at a scale of 1:200 000. This route, after the MSPPSA is approved, will bypass the BC-Wind OWF Area from the east. The proposed change in the course of the route will slightly extend it, which will result, to a certain extent, in the negative phenomena proportional to the change in the length of the route, i.e.: the increased costs and length of sailing time, the increased emissions (CO₂, CO, SO₂, NO_x), the increased probability of failure and accidents (assuming that the probability is proportional to the distance travelled).

South of the BC-Wind 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 [517]. The AIS data demonstrate that in the years 2018–2020 vessels travelled approx. 26 000 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 BC-Wind 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 [517]. The AIS data demonstrate that in the years 2018–2020 vessels travelled approx. 8000 times using this route. The BC-Wind OWF Area is used to a small extent by recreational vessels.

3.9.2 Fishery

Activity related to the fishing industry is carried out in the BC-Wind OWF Area. The characteristics of this activity were prepared on the basis of catch report data from fishing vessels, accounting for the location of catches (statistical rectangle or geographical position), fish species, month of catches, fishing gear and vessel size (vessels <12 m and ≥12 m long).

The criterion of 12 m was adopted for the purpose of differentiating between the vessels which can be classified as small-scale coastal fishing vessel (<12 m) in accordance with the provisions of the Council Regulation (EC) No. 508/2014. The data from the catch reports may differ from the landing (final) data; however, adopting them as a basis was necessary for preparing the geographical distribution of the fishing activity (landing reports do not contain precise location data of catches). Any possible differences are insignificant and should not affect the conclusions reached. The analysis is based on the catch data from the years 2015–2019. The value of catches was calculated by multiplying the average annual first-sale prices for each species of fish by the weight of the fish caught. Since more detailed data on the catches of the fishing fleet are available for the statistical rectangle areas (surface area of approx. 400 km²) that do not coincide with the BC-Wind OWF Area, the following was taken into consideration to determine, with the greatest possible accuracy, the impact of the project on the fisheries within the area of the OWF itself:

- for fishing boats **exceeding 12 m** in length, equipped with a Vessel Monitoring System (VMS), the daily catch volume was assigned to a particular statistical rectangle or the OWF Area on the basis of the proportion of the number of vessel position reports provided within a particular statistical rectangle 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 rectangle 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 that will be covered by the OWF compared to the total surface area of the statistical rectangle. With this simplification, the possible diversification of the catch volumes within a particular statistical rectangle (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 BC-Wind OWF Area is located unevenly within the two statistical rectangles: O8 and P8 [Figure 3.19, Table 3.26].



Figure 3.19. Location of the BC-Wind OWF Area against the background of statistical rectangles [Source: internal materials]

Table 3.26. Surface area covered by the BC-Wind OWF Area (1 NM) in individual statistical rectangles used in calculations of catch volumes of vessels with a length of up to 12 m [Source: internal materials]

Statistical rectangle	Statistical rectangle surface covered by the OWF Area (1 NM) [%]
O8	7.47
P8	15.08
Total	11.27

3.9.2.1 Volume and value of fish catches

The average annual volume of fish catches in the area of the two rectangles analysed amounted to approx. 865 tonnes in 2015–2019, which constituted only 0.6% of the total volume of the Polish Baltic catches by the Polish fishery over that period. The value of catches in the area of the two rectangles analysed amounted to approximately PLN 1.3 million, which constituted 0.6% of the total value of landings from the Polish catches in the Baltic Sea.

In the years 2015–2019, the estimated volume of catches (for the vessels with a length of <12 m, calculated on the basis of the proportion of the surface area covered by the OWF in each statistical rectangle and on the basis of the VMS data for vessels with a length of ≥12 m) carried out in the BC-Wind OWF Area was on average 174 t with a value of PLN 238 000.

The area of the rectangles analysed is characterised by a low fishing productivity. In the years 2015–2019, the average volume of catches per km², carried out in the area of the two statistical rectangles, was 1100 kg/km², with a value of PLN 1.5 thousand. This constituted only 36% (33% in terms of value)

of the average PMA productivity, which was 3000 kg/km² valued at PLN 4.6 thousand/km² in the years analysed. The Baltic rectangle marked P8 is characterised by a significantly higher productivity of 2000 kg/km² (PLN 2.4 thousand/km²) – than the O8 rectangle – 220 kg/km² (PLN 0.6 thousand/km²). Of the 123 Baltic rectangles situated in the PMA (partially or entirely), the P8 rectangle occupied a distant 55th position in terms of catch volume per km² of the surface area.

The average share of fish caught in the years 2015–2019 within the rectangles located in the region of the planned project in relation to the total Polish catches in the Baltic Sea was 0.6%, whereas for the area of the OWF itself it was 0.11%. Analysing the relative significance of the area of statistical rectangles, which are to be partially occupied by the BC-Wind OWF Area, as the location of catches for fishing vessels registered in various ports, it can be concluded that only for vessels from Władysławowo it plays a perceptible, although still marginal role (1.6%) [Table 3.27]. For the vessels registered in other ports, catches conducted in the area of the two rectangles analysed can be considered negligible, their relative volume did not exceed 1% for any of the rectangles (on average in the years 2015–2019). The area analysed was of similar low significance in terms of value in the years 2015–2019 [Table 3.28].

Table 3.27. Average volume [t] of catches in O8, P8 statistical rectangles in the years 2015–2019, in reference to the average value of the Polish catches in the Baltic Sea, as divided into fishing vessel registration ports and sizes [Source: internal calculations based on FMC data]

Port	Statistical rectangles O8, P8			BC-Wind OWF Area			The Baltic Sea	Percentage share [%]	
	<12 m	>12m	Total	<12 m	>12m	Total		In the statistical rectangles	In the OWF Area
Władysławowo	3.6	706.4	710.1	0.5	154.7	155.3	43 894.8	1.6	0.4
Ustka	2.1	98.6	100.8	0.2	11.6	11.8	16 664.3	0.6	0.1
Hel	0.6	23.8	24.3	0.0	2.0	2.1	12 375.4	0.2	0.0
Łeba	0.0	18.3	18.4	0.0	2.6	2.6	2766.2	0.7	0.1
Jastarnia	0.0	6.0	6.0	0.0	1.0	1.0	6081.9	0.1	0.0
Świnoujście	1.3	0.3	1.5	0.1	0.0	0.1	3951.9	0.0	0.0
Kołobrzeg	1.3	0.0	1.3	0.2	0.0	0.2	37 659.1	0.0	0.0
Other	1.4	1.2	2.5	0.2	0.5	0.7	19 030.8	0.0	0.0
Total	10.2	854.6	864.9	1.3	172.4	173.7	142 470.6	0.6	0.12

Table 3.28. Average value [in thousands of PLN] of catches in statistical rectangles (O8, P8) and in the BC-Wind OWF Area in the years 2015–2019 referred to the average value of the Polish catches in the Baltic Sea, divided into fishing vessel registration ports and sizes [Source: internal calculations based on FMC data]

Port	Statistical rectangles O8, P8			BC-Wind OWF Area			The Baltic Sea	Percentage share [%]	
	<12m	>12m	Total	<12 m	>12m	Total		In the statistical rectangles	In the OWF Area
Władysławowo	15.4	838.7	854.1	2.3	197.3	199.7	47 566.5	1.8	0.4
Ustka	33.7	154.1	187.7	3.1	16.4	19.5	26 930.5	0.7	0.1
Hel	4.6	29.4	34.0	0.5	2.6	3.1	11 947.1	0.3	0.0
Łeba	0.2	72.2	72.3	0.0	10.2	10.2	4965.4	1.5	0.2
Jastarnia	0.0	6.0	6.0	0.0	0.9	0.9	7468.4	0.1	0.0
Świnoujście	2.6	1.0	3.5	0.2	0.0	0.2	7041.4	0.1	0.0

Port	Statistical rectangles O8, P8			BC-Wind OWF Area			The Baltic Sea	Percentage share [%]	
	<12m	>12m	Total	<12 m	>12m	Total		In the statistical rectangles	In the OWF Area
Kołobrzeg	3.1	0.0	3.1	0.5	0.0	0.5	49 664.6	0.0	0.0
Other	10.6	7.8	18.3	1.4	2.3	3.7	49 530.7	0.0	0.0
Total	70.1	1109.0	1179.1	8.1	229.7	237.8	205 340.3	0.6	0.12

The volume and value of fish catches in individual statistical rectangles, in which the BC-Wind OWF Area is located, is diversified. As shown in figures [Figure 3.20, Figure 3.21], the volume of catches in the rectangles under analysis fluctuated in successive years, with a visible decreasing tendency in rectangle O8. This was due mainly to the deteriorating state of cod stocks, particularly evident in the coastal zone. On the other hand, catches in rectangle P8 fluctuated due to variable activity of vessels fishing for pelagic species in the rectangle area.

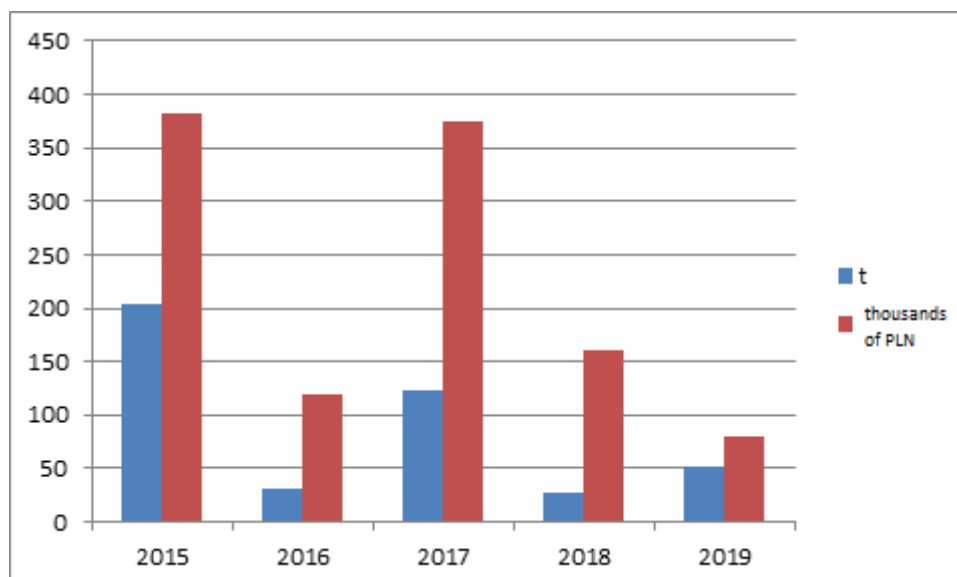


Figure 3.20. Volume [t] and value [PLN] of the catches carried out in statistical rectangle O8 [Source: internal materials based on FMC data]

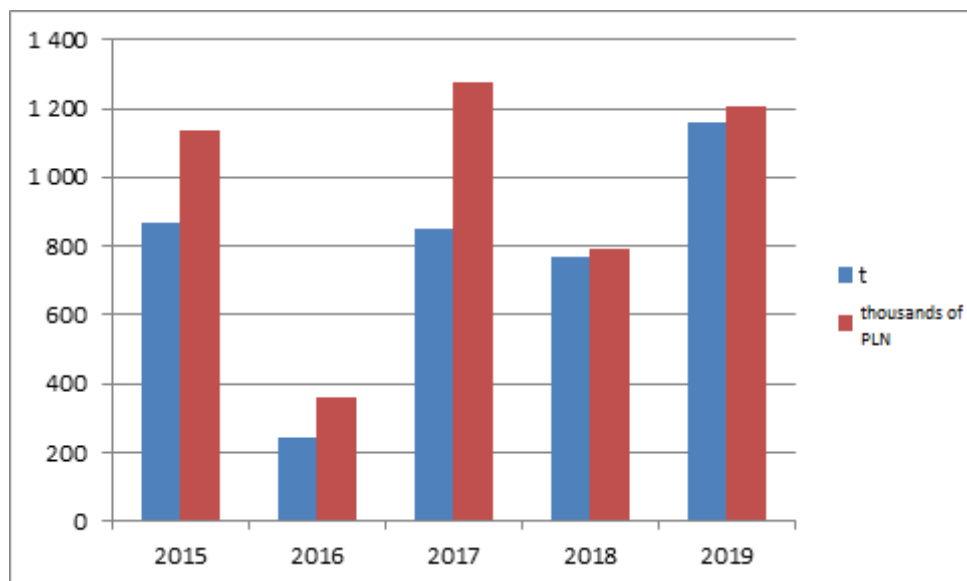


Figure 3.21. Volume [t] and value [PLN] of the catches carried out in statistical rectangle P8 [Source: internal materials based on FMC data]

The main fish species caught within the two rectangles analysed in the years 2015–2019 were herring and sprat [Table 3.29], corresponding to 65% and 31% of the total catch volume, as well as 61% and 20% of the value of fish caught, respectively [Figure 3.22]. The remaining share was constituted by other fish, among which sea trout, salmon and flounder prevailed.

Table 3.29. The volume and value of the catches in the statistical rectangles O8 and P8 in the years 2015–2019, divided into more significant species [Source: internal calculations based on FMC data]

Species	Catch parameter	Year				
		2015	2016	2017	2018	2019
Cod <i>Gadus morhua</i>	Volume [t]	53.5	15.7	17.8	7.8	4.6
	Value [in thousands of PLN]	241.8	75.3	88.6	39.3	23.8
Herring <i>Clupea harengus</i>	Volume [t]	898.8	184.0	835.1	292.9	585.3
	Value [in thousands of PLN]	1153.4	256.8	1160.3	325.5	710.5
Sprat <i>Sprattus sprattus</i>	Volume [t]	106.8	58.0	102.0	467.7	619.4
	Value [in thousands of PLN]	99.5	54.1	90.7	356.6	549.1
Other	Volume [t]	12.7	16.2	19.6	25.9	0.6
	Value [in thousands of PLN]	27.0	94.7	313.0	232.3	3.4
Total: volume [t]		2442.1	1071.8	273.9	974.6	794.4
Total value [in thousands of PLN]		6938.1	1521.7	481.0	1652.6	953.6

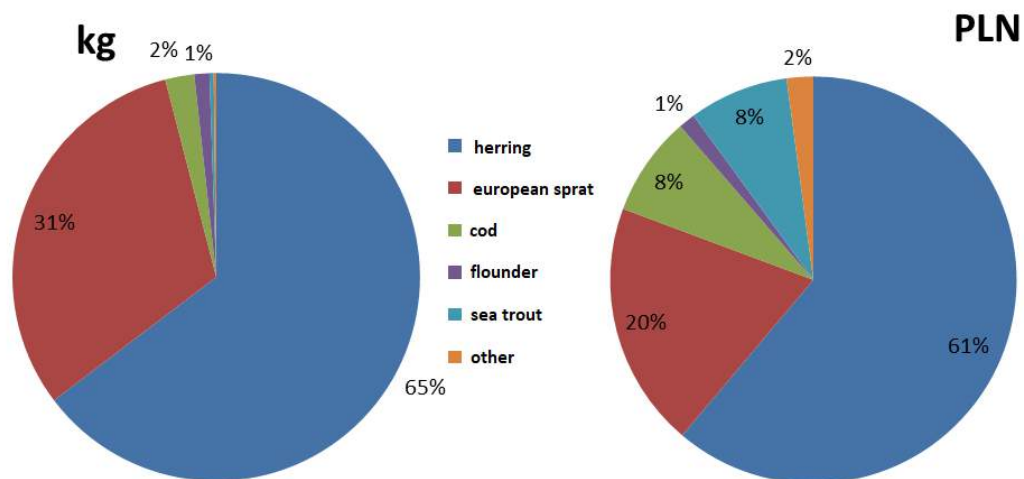


Figure 3.22. The species structure of catches within the statistical rectangles O8 and P8 in the years 2015–2019 [Source: internal materials based on FMC data]

In the period under analysis, the vast majority of catches, both in terms of quantity and value, were made by fishing vessels ≥ 12 m of total length [Table 3.30]. This was due both to the prevalence of large vessels as well as their higher fishing capacity. In the years 2015–2019, the share in the volume and value of catches of this vessel group exceeded 90%, with the exception of the 2018 figures.

Table 3.30. Volume and value of catches in statistical rectangles O8, P8 in the years 2015–2019, as divided into fishing boat lengths [Source: internal materials based on FMC data]

Catch parameter	Vessel group by length [m]	Year				
		2015	2016	2017	2018	2019
Volume [t]	<12	24.5	5.2	15.2	6.2	0.2
	≥ 12	1047.3	268.7	959.3	788.2	1209.7
Value [in thousands of PLN]	<12	87.0	31.3	56.2	174.4	1.5
	≥ 12	1434.7	449.6	1596.4	779.2	1285.1
Total volume [t]		1071.8	273.9	974.6	794.4	1209.9
Total value [in thousands of PLN]		1521.7	481.0	1652.6	953.6	1286.7

Significantly deviating from the average, the value of catches in 2018 (PLN 174 thousand) in the group of <12 m vessels was related to an incidental increase in the activity of vessels fishing for salmonids (mainly sea trout) with longlines within the area of rectangles. In other years, catches of these fish were of marginal importance. Changes in the ≥ 12 m vessel catches were characterised by high variability between 2015 and 2019, fluctuating between 450 tonnes and 1600 tonnes. The changes observed did not reflect the overall changes in catches of either herring or sprat (the two most important species caught) in the Baltic Sea, which would indicate the impact of random factors on the changes in the values observed.

The calculation results for catch volumes in individual statistical rectangles and values of catches conducted in the BC-Wind OWF Area are presented in Table 3.31. As mentioned in the preface, for <12 m vessels, the value of catches in the OWF Area was calculated in proportion to the area to be occupied by the OWF Area in a given statistical rectangle, whereas for the ≥ 12 m vessels – on the basis of VMS data. In 2015–2019, the average value of catches for <12 m vessels amounted to PLN 8100,

while for ≥ 12 m vessels – PLN 229 700. As mentioned earlier, the changes observed in catch volumes over the period analysed were random in nature.

Table 3.31. Value of catches in statistical rectangles P8, O8 in the years 2015–2019 and the estimated value of catches in the BC-Wind OWF Area [Source: internal materials based on FMC data]

Vessel group by length [m]	Statistical rectangles	Value of catches in the statistical rectangles [in thousands of PLN]					Estimated value of catches in the BC-Wind OWF Area [in thousands of PLN]					Mean	
		2015	2016	2017	2018	2019	2015	2016	2017	2018	2019	Statistical rectangles	BC-Wind OWF
<12	O8	12.9	2.6	34.3	111.3	1.5	1.1	0.2	3.0	9.6	0.1	32.5	2.8
	P8	74.1	28.7	21.8	63.0	-	10.7	4.2	3.2	9.1	-	37.5	5.4
Total		87.0	31.3	56.2	174.4	1.5	11.8	4.4	6.1	18.7	0.1	70.1	8.2
>12	O8	370.0	116.7	340.1	48.6	77.7	92.5	6.4	73.3	5.1	19.4	190.6	39.3
	P8	1064.7	332.9	1.256,2	730.6	1207.4	288.5	70.2	276.2	68.7	191.8	918.4	179.1
Total		1434.7	449.6	1596.4	779.2	1285.1	381.0	76.6	349.5	73.8	211.1	1109.0	218.4
Total		1521.7	481.0	1652.6	953.6	1286.7	392.8	81.0	355.6	92.5	211.3	1179.1	226.6

The analysis of the monthly variability of fish catches in the BC-Wind OWF Area is important from the point of view of planning construction works by the investor and possibly accounting for the least interference with fisheries during such works. The analysis indicated a significant variability and spread of monthly catch values. In 2015–2019, they ranged from PLN 600 (December 2016) to even PLN 440 000 (September 2015). Due to the relatively small number of fish caught in both rectangles, the monthly variation in catches was influenced by the involvement of individual vessels. In the years analysed, approx. 50% of the catch volume was achieved by only 3–4 fishing vessels; therefore, the total catch achieved in the rectangles could be determined by individual decisions of vessel masters regarding the location of fishing. Nevertheless, the analysis of data from the years 2015–2019 reveals a certain seasonality of catches. The average monthly value of catches amounted to PLN 98 thousand. The value of catches in the spring months (March–May) as well as in November and December was below this average value [Figure 3.23]. The highest relative value of catches in the years 2015–2019 was recorded in February (17%) as well as August and September, 13% each [Figure 3.24].

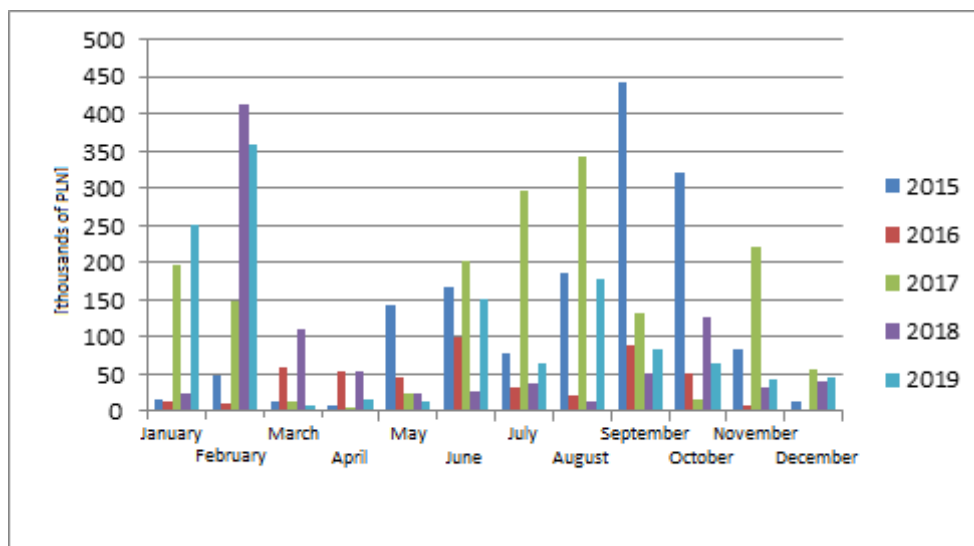


Figure 3.23. Monthly value of catches [in thousands of PLN] in the area of statistical rectangles O8 and P8 in the years 2015–2019 [Source: internal materials based on FMC data]

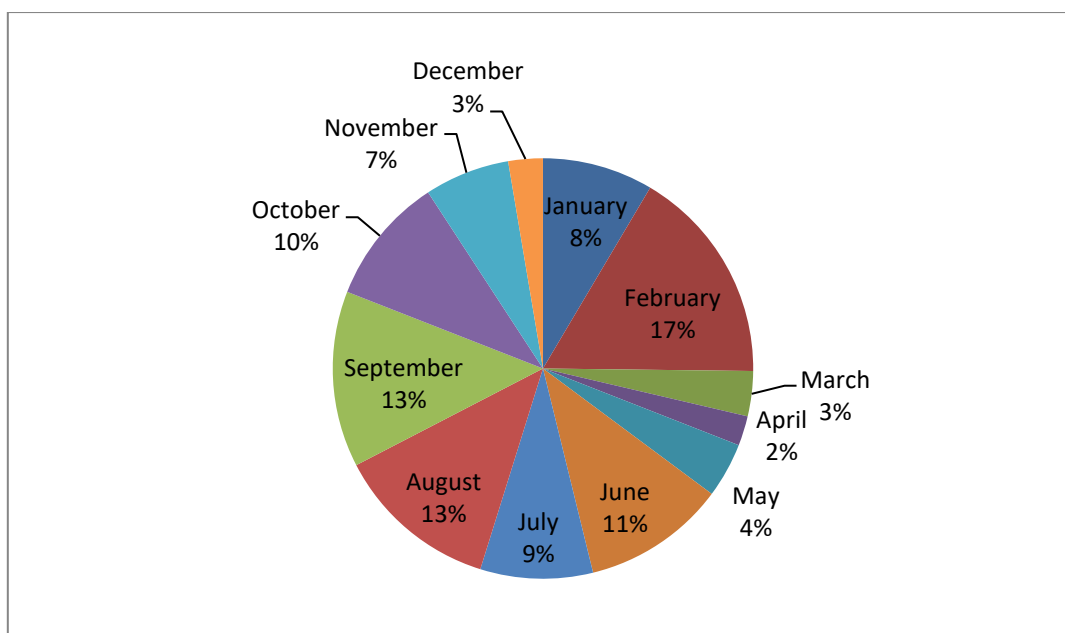


Figure 3.24. Relative value of catches in rectangles O8 and P8 by month, in the years 2015–2019 [Source: internal materials based on FMC data]

Regarding fishing methods in the BC-Wind OWF Area in 2015–2019, pelagic trawls were used predominantly. With the exception of 2018, they accounted for more than 80% of the total catch value [Figure 3.25]. The main species caught with this gear were herring and sprat.

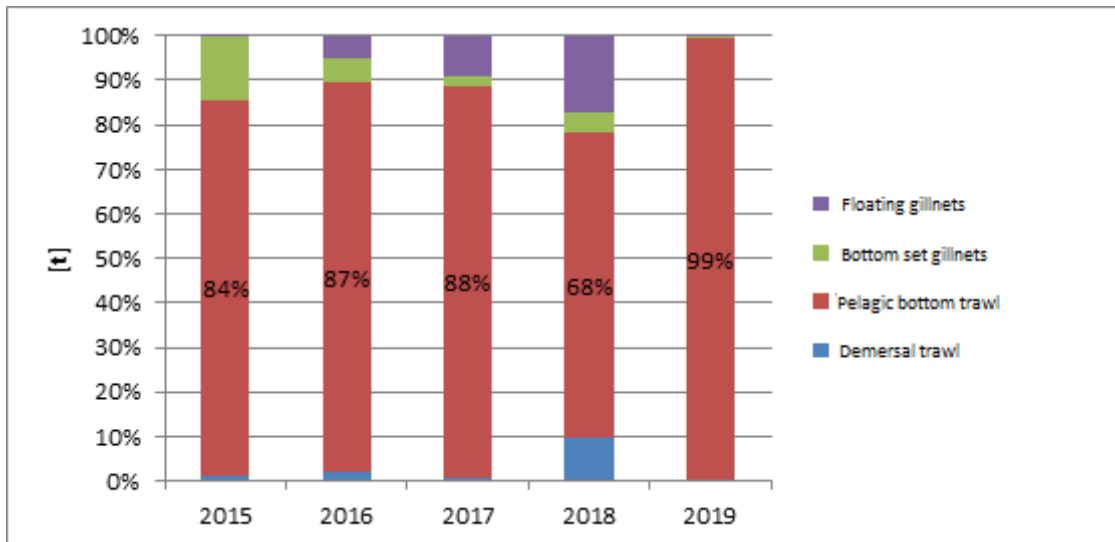


Figure 3.25. Volume of catches conducted using particular type of fishing gear in the area of statistical rectangles O8 and P8 in the years 2015–2019 [Source: internal materials based on FMC data]

3.9.2.2 Fishing effort

In the years 2015–2019, fish catches in the area of statistical rectangles O8, P8 were conducted by 57, 46, 55, 63 and 41 vessels respectively, compared to a total of 810, 812, 797, 777 and 786 active fishing vessels respectively conducting catches in the Baltic Sea (in the Polish Exclusive Economic Zone and beyond it). Fishing vessels with lengths exceeding 12 m prevailed, with an average of 90% share in the entire period under analysis.

In the years 2015–2019, the total fishing effort (measured by the number of fishing days) in the area of the two rectangles ranged from 468 days in 2017 to 214 days in 2019. The vast majority – almost 90% of the effort volume calculated in fishing days, was concentrated in rectangle P8 (characterised by greater water depth compared with the area of rectangle O8). The relative significance of the area of the two rectangles analysed in the total fishing effort of the Polish fishing fleet conducting catches in 2019 in the Baltic Sea (approx. 65 thousand days) was negligible, at approx. 0.3%.

3.9.3 Other developments

There are no structures permanently fixed to the seabed in the BC-Wind 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.

3.10 Landscape, including the cultural landscape

The location of the BC-Wind OWF covers an area situated approx. 22.6 to 31 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 rarely visible from the BC-Wind OWF Area.

People are rarely present in the BC-Wind OWF Area. Important regular and planned shipping routes run across the BC-Wind OWF Area [Figure 3.26] and within its region at a distance 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. On the northern side of the BC-Wind OWF Area, the proposed new north-east shipping route corridor is supposed to run, but it has not yet been established. Additionally, the MSPPSA project also foresees that part of the shipping will be redirected from the southern to the northern and eastern side of the BC-Wind OWF Area.

The BC-Wind OWF is located in parts of two statistical rectangles and the movement of fishing boats takes place there [Figure 3.26]. 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 38 km, i.e. outside the scope of visibility from the BC-Wind 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.

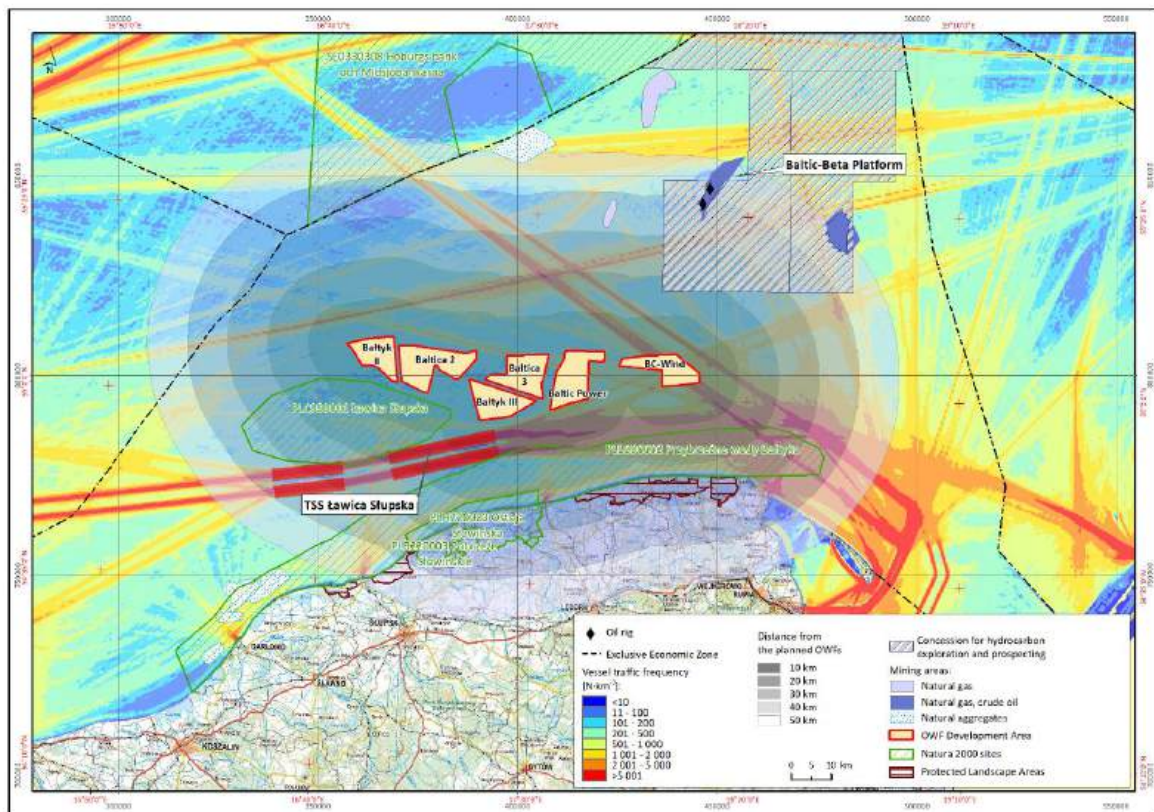


Figure 3.26. Development and use of the surrounding sea area; red – sections of routes, the possible modification of which requires international agreements and an approval of the OWF Area by the IMO [Source: internal materials]

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. There are no fixed elements of development in the BC-Wind OWF Area and its vicinity.

Within the area of the OWF potential impact on the landscape there is a land area in the section from Łeba in the west to Jastrzębia Góra in the east. Due to the shape of the coastal zone, the BC-Wind OWF can be seen from the beaches in this section. According to the physico-geographical division of Poland [224], 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 bogs 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 there. These are: the Protected Landscape Area "Coastal Belt west of Ustka", the nature and landscape complex "Ostoja Łąbędzi" 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 BC-Wind 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 BC-Wind OWF Area, is characterised by a low birth rate 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 turbines 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 theoretically determined centre of the BC-Wind OWF is located in the following distances from the nearest ports:

- Łeba – 45.5 km;
- Władysławowo – 40 km;
- Ustka – 93.0 km;
- Darłowo – 126.7 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 BC-Wind OWF can be potentially located in the ports of Gdańsk and Gdynia, which are 110 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 600 vessels, which used the BC-Wind OWF Area in 2019.

The BC-Wind OWF Area is a place of fishing activity. This area is situated in parts of the two statistical rectangles: O8 and P8. The issues related to fishery are described in detail in subsection 3.9.2.

Summing up, it should be noted that in the context of the currently applicable Maritime Spatial Plan of Polish Sea Areas and no planned restrictions on fishery, the construction of the BC-Wind OWF is of low 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 works 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 flying seabirds with wind turbines (Appendix 4 to the EIA Report).

Moreover, based on the results of the 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 the suspended solids dispersion, underwater noise propagation, collisions with wind turbines 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.

A numerical model used reflects the transport of suspended solids in the dynamic marine environment during underwater and dredging works on the seabed in the area intended for the BC-Wind OWF project.

The results obtained from the numerical model taking into consideration the forcing conditions (wind, currents), allowed for analysing the impact of these conditions on the specific parameters of suspended solids (concentration level, dispersion range, retention time in the water depth, and sediment thickness). The method of performing the calculations and interpreting the results 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 OWF, which interfere in the marine environment the most. The results of the numerical simulations performed lead to the following conclusions:

- during the weakest environmental forcings, i.e. at low wind speeds responsible for the generation of currents of the lowest velocities (around several $\text{cm}\cdot\text{s}^{-1}$) and additionally at a circular, chaotic nature of the current field with low velocities, the suspended solids concentrations reach their highest values;
- the greatest impact ranges of the suspended solids occur at moderate winds, the direction of which is determined in the period of underwater works implementation causing the suspended state of fine soil fractions in the water depth (seabed preparation for the support structure, power cable burying in the seabed);
- the higher suspended solids concentrations (from 30 to more than $100 \text{ mg}\cdot\text{l}^{-1}$) have a local range in relation to the location of the dredging works conducted and their impact range does not exceed a distance of 1000 m;

- avoidance of the cumulative impact related to the increase in the suspended solids concentration 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 cumulation effect of the suspended solids concentration does not occur for various types of underwater works causing the suspension of sediments in the water depth, because the implementation periods of those works do not overlap, and additionally, the suspension retention time, in the most unfavourable conditions, after the completion of activities, does not exceed a dozen of hours (11–14);
- the greatest thickness of the newly-formed sediments in the worst-case 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 25 mm in the case of work related to the preparation for the foundation, 7 mm in the case of power and telecommunication cable laying using the jetting method, and 21 mm in the case of laying power and telecommunication cables using the mass flow excavation method;
- the thickness of the newly formed sediments (with suspended solids sedimentation) at a distance of 1000 m from the site of the work carried out do not exceed 4 mm;
- the effect of accumulation of the newly formed sediments caused by various anthropogenic activities during the construction phase (preparatory work for foundations 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 the near-seabed current velocity) will be responsible for the changes in the thickness of sediments in the BC-Wind OWF Area and outside of it during the OWF operation phase;
- the impact of suspended solids on the marine environment in the worst-case scenario does not exceed 62 hours from the beginning of work in the seabed on a single foundation, i.e. 14 hours from the moment of the completion of work on the foundation (this condition is determined by the moment of reaching the negligible concentration, lower than $4 \text{ mg} \cdot \text{dm}^{-3}$);
- 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;
- the sediments mobilised will be the natural and local ones;
- generally, the total cubature of the works mobilising the suspended solids (preparatory works for a turbine foundation and excavations for burying cables within the OWF area) in the entire BC-Wind OWF Area, would cause the formation of a layer with a thickness of approx. 0.8 mm, both in the Applicant Proposed Variant and the Rational Alternative Variant.

4.2 Modelling of underwater noise propagation

Underwater noise shall be emitted to the environment in every phase of the BC-Wind OWF implementation (construction, operation, and decommissioning). However, its greatest impact is expected at the time of construction due to the high level of noise generated during pile driving. Marine organisms, such as fish or marine mammals, are sensitive to sound; therefore, noise accompanying the operations related to an OWF construction can have an impact on them at

considerable distances. The OWF construction methods and the bathymetric and hydrological conditions specific for this project are decisive in terms of the underwater noise propagation. Thus, the modelling of underwater noise propagation during the OWF construction was estimated in the detailed analysis, taking into consideration the unique nature of the project.

The analysis was carried out for the worst-case scenario (piling of the foundation and/or supporting structure with a diameter of 12 m) using the numerical modelling of underwater noise. Based on acoustic modelling results, the zones of sound impact (i.e. the distance from the sound source) on marine mammals (seals and porpoises) and fish with a swim bladder and without a swim bladder, which can be affected by 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 noise emission minimisation measures such as a big bubble curtain (BBC) placed around the equipment used for pile driving into the seabed. The curtain generates a circle of bubbles around the pile driving area, which results in 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 an NRS.

The modelling results for the BC-Wind OWF indicate that the spreading of sound depends on the seabed topography, which results in differences in the directivity of sound intensity. This is illustrated on numerous maps, which show the horizontal propagation of sound from the modelling location selected in the area of the planned BC-Wind OWF in the Baltic Sea. It can be clearly deduced from them, that sound levels are lower in the north-western and south-western directions.

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, 1.8 km and 0.1 km for the BC-Wind OWF Area, respectively. On the other hand, the temporary threshold shift (TTS) may occur at the distance of 12 km for the porpoise and 1.8 km for the seals. Up to 150 km from the location surveyed, changes can occur in the porpoise behaviour, whereas, up to 19 km – in the seal's. The behavioural criterion is based on values, which do not take into account the animal hearing sensitivity, thus, they should be treated with caution.

With the use of mitigation measures in the form of an NRS, the impact zones for a single strike are subject to significant decrease. The PTS occurrence range for the porpoise is reduced to 0.2 km, and for seals to below 0.1 km. While the TTS may occur at a distance of up to 1.8 km for the porpoise, and of up to 0.1 km for seals. The behavioural response after the NRS application decreases to the distance of 28 km for the porpoise, and 3.5 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, an impact in the form of PTS for the porpoise and the seal can be expected at the distances of 82 and 21 km respectively in the BC-Wind OWF Area. On the other hand, TTS will occur at the distance of 150 km for the porpoise and 140 km for the seal. The use of mitigation measures in the form of an NRS reduces significantly the impact range for repeated strikes, so that PTS ranges are less than 12 km and 1 km for the porpoise and the seal, respectively. The TTS ranges will decrease to 36 km for the porpoise and 7.8 km for the seal.

In addition to the static approach, the moving receiver method was used to calculate the impact ranges for marine mammals trying to move away from the sound source. Without noise reduction measures, these ranges were greater than the distances in the static approach because the moving receiver model covers 6-hour noise accumulation period, while the static model is based on 1-hour exposure to sound. When the noise minimisation measures in the form of an NRS were implemented, the impact ranges in the moving receiver approach were generally smaller than the ones in the static approach. In the case of moving animals and the application of the noise reduction measure in the form of an NRS, the PTS in porpoises can be expected at a distance up to 7.7 km and in seals up to 0.1 km. The TTS ranges are 41 km for the porpoise and 6.8 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 0.3 km, respectively. However, a behavioural response should be expected at the distance of 150 km in fish with and without a swim bladder. A big bubble curtain would mitigate the range of behavioural response up to the distance of 23 km in fish without a swim bladder and 59 km in fish with a swim bladder.

The estimates relating to the repeated pile driver strikes indicate the PTS in fish with a swim bladder and without it at a distance of 5.8 km and 0.9 km, respectively. The values decrease after the NRS is used to 0.7 km and 0.1 km, respectively. The occurrence of TTS reaches up to 46 km for both types of fish and decreases to 8 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 are on-going discussions on some of the criteria applied when calculating the impact zones related to repeated strikes. Therefore, the results of the modelling of a series of sounds generated as a result of repeated pile driver strikes during piling should be treated with caution.

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 the 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 detailed methodology and the results of modelling surveys on the noise propagation are included in Appendices 1 and 2 to the EIA Report.

4.3 Modelling the risk of bird collision

Due to their size, wind turbines, both onshore and offshore, may potentially generate a negative impact in the form of collisions of flying birds with the components of wind turbines. This applies particularly to the moving parts of a power station, i.e. the 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 [24]. This model assumes that a certain proportion of the birds flying across the survey area are within the rotor range. To estimate the risk of bird collisions, quantitative data on the birds migrating across the survey area is required as well as the information on the parameters of individual wind turbines as well as the entire OWF. It is assumed that the probability of collision with a rotor depends on the bird's size (wingspan and wing area), blade range and angle, rotor speed and the speed of the bird's flight. In the case of reduced visibility (low clouds, night, dense fog), birds are able to spot

the obstacle that is the OWF from a shorter distance than in good visibility conditions, which results in a higher risk of collision. During analyses both the Applicant Proposed Variant and the alternative variant were tested together including the different ranges of the clearance height between the lower range of the rotor and the water surface.

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

5 Description of the effects on the environment predicted in the case the project is not implemented, taking into account environmental information and scientific knowledge available

Failure to implement the project consisting in the construction and operation of the BC-Wind 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 BC-Wind OWF project with a power output of 500 MW and 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 BC-Wind OWF itself would cover approx. 1.3% of national electric power demand), which would require a compensation through operation 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 operation, a 500 MW OWF can generate 55.85 TWh/201.05 PJ of electricity, thus, avoiding the emission of over 20 million Mg CO₂, over 270 thousand Mg SO₂, about 37 thousand Mg of nitrogen oxides and more than 0.625 million Mg of dust in lignite-fired power plants [111].

The above option will lead to 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, operation and decommissioning of these elements of the OWF will not occur over a period of several dozen years. This also results in 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 OWFs 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 Project impacts identification and assessment

This impact analysis was carried out separately for the construction phase, the overlapping construction and operation phases (from 2 to 3 years – up to 5 years), as well as operation and decommissioning phases of the OWF.

6.1 Applicant Proposed Variant (APV)

6.1.1 Construction phase

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

A significant element 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 Table 6.1.

Table 6.1. Sensitivity of seabed topography to impacts resulting from the activities related to the OWF construction [Source: internal materials]

Sensitivity	Description
Irrelevant	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 turbines 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 seabed relief due to: preparing the seabed for the foundation or support structure, laying of cables, levelling of the 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 result in water turbidity. Suspended solids generated as a result of sediment disturbance during dredging works are deposited at the seabed depending on the water dynamics 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 to be 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 turbines) 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 in points, if 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 all of the cases listed above, except for the floating foundations. In the vicinity of individual wind turbines, 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 BC-Wind OWF Development Area will not be greater than 86.28 km². Changes in the nature of surface sediments will concern the seabed intended for foundations of 41 wind turbines (0.12 km²; with the proposed maximum diameter for a gravity-based structure of 60 m; Applicant's variant), which constitutes only 0.14% of the Development Area or 62 wind turbines (0.1 km²; with the proposed

maximum diameter for the gravity based structure of 45 m; alternative variant), which constitutes only 0.12% of the Development Area. The impact on surface sediments will be negligible.

Changes in the nature of surface sediments when laying cables, with the expected length of cable routes amounting to 188 km (Applicant's variant and the alternative variant), depending on the method used for burying the cable in the seabed, will concern from 0.282 km² (with the application of jetting method; a change in the nature of the seabed surface within 1.5 m wide strip) to 2.06 km² (when the cable is buried by digging trenches using a dredger; a change in the nature of the seabed surface within a strip up to 11 m wide), which constitutes from 0.3 to 2.4% respectively of the seabed surface in the Development Area. The impact on surface sediments will be negligible.

6.1.1.2 Impact on the seawater and seabed sediment 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. Such conditions make every interference in the marine environment – fisheries, shipping, discharge of municipal and industrial wastewater, surface water runoff from industrial and agricultural areas, but also activity related to the operation and development of the seabed – affect the delicate ecological balance of the marine ecosystem [466]. 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 characterised by 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 [42]. Sediments, however, are not only a place of deposition of persistent and toxic pollutants reaching the environment but also a place of existence, source of nourishment, place of reproduction and growth of numerous aquatic organisms. 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 [131, 48].

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 their construction phase OWFs 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 the construction of the BC-Wind 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 [466, 42, 131, 48, 98]. During construction

works, substances including labile metal forms, POPs, i.e. 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 and/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 the 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 a greater amount of 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 fractions and low concentrations of metals and POPs. Therefore, it is estimated that the processes related to the release of nutrients and POPs will occur at low intensity in the entire BC-Wind OWF Area.

It should be emphasised that the substances released from the sediment will pass into water. However, within approx. 1 year from the completion 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 RAV and in the APV. Their construction requires the preparation of the seabed, which may involve the removal of a layer of seabed sediments, not only where the foundation and/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 piles driven 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 12.00 m is presented below. Given that the 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:

$$V_a = V_{tr\ cone} - V_{cyl.\ III}$$

where:

V_a – volume of the sediment layer disturbed during pile driving into the seabed,

$V_{tr\ cone}$ – volume of the truncated cone,

$V_{cyl.\ III}$ – volume of the cylinder III.

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. 66 m³ of sediment per foundation or support structure.

Additionally, regardless of the type of foundation and/or support structure selected, sediment will be disturbed during cable laying. The cross-section of a cable trench during cable laying by dredging and backfilling is a trapezoid with an 11 m base at the top of the trench and a 3 m base at the bottom, with an average depth of up to 2 m and a length of up to 188 km, which amounts to 2 632 000 m³ of disturbed sediment (for the entire internal cable network). By contrast, laying the cable by jetting will result in sediment disturbance in a trench up to 2 m deep, with a trapezoidal cross-section with a 1.5 m base at the top of the trench and a 3 m base at the bottom while the layer of sediment disturbed by the dredging tool is 7 m wide and 0.01 m deep. Given the anticipated cable route length of up to 188 km, this will amount to 470 000 m³ of disturbed sediment (for the entire internal cable network). This is the preferred scenario.

Moreover, during the construction of foundations and/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.

On the basis of the above assumptions and the concentration of pollutants and nutrients found in the OWF Area (cf. subsection 3.2.2) the size of their emission into the water in the APV and RAV was estimated.

The calculations assume an average dry sediment density of 1.6 g·cm⁻³ (1600 kg·m⁻³) and an average sediment moisture content of 18.6%. For the purpose of calculations, the volume of sediments necessary to be removed for the correct installation of the GBS foundation and/or support structure was assumed as 11 280 m³ (APV) and 6930 m³ (RAV). To calculate the weight of pollutants, which may be transferred into the water during the laying of the internal cable network, the most unfavourable variant from the point of view of the amount of sediment disturbed was adopted, i.e. the digging of a trench for the cable by dredging and backfilling, which can disturb 14 000 m³ of sediment per 1 km of cable and the jetting method of cable laying adopted as the preferred one, which will disturb a much smaller volume of sediment per one linear kilometre of the cable, i.e. 2500 m³.

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 BC-Wind OWF project is presented in Table 6.2.

In the case of indicators, the concentration of which during the environmental surveys conducted was below the lower limit of quantification (LOQ) of the survey methods applied to calculate the load (for illustrative purposes), the values of this limit (marked with "<" in Table 6.2) were adopted.

The table also presents, for comparative purposes, the loads entering annually the Baltic Sea with the rivers of Poland and with precipitation [466]. The results of the State Environmental Monitoring carried out by CIEP in the years 2003–2012 were also used. As it was shown, the estimated results obtained for the re-mobilisation of individual indicators are insignificant.

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Table 6.2. Comparison of the mass of pollutants and nutrients that may be released into water during the construction of the BC-Wind OWF (construction phase, APV, RAV, cable laying) with the load entering the Baltic Sea through rivers and rain [Source: internal materials]

Parameter	One gravity-based structure (GBS)	APV (41 foundations)	RAV (62 foundations)	1 km of cable (trench by dredging)	Cable routes (188 km)	1 km of cable (burying by jetting)	Cable routes (188 km)	Annual load entering the Baltic Sea through rivers	Annual load entering the Baltic Sea through rain
Volume of the sediment disturbed	11 280m ³ (APV) 6930 m ³ (RAV)	462 480 m ³	429 660 m ³	14 000 m ³	2 632 000 m ³	2500 m ³	470 000 m ³	No data available	No data available
Weight of the sediment disturbed	14 691 Mg (APV) 9026 Mg (RAV)	602 334 Mg	559 589 Mg	18 234 Mg	3 427 917 Mg	3256 Mg	612 128 Mg	No data available	No data available
Dry weight of the sediment disturbed	11 959 Mg (APV) 7347 Mg (RAV)	490 300 Mg	455 506 Mg	14 842 Mg	2 790 324 Mg	2650 Mg	498 272 Mg	No data available	No data available
Lead (Pb)	29.0 kg (APV) 18.0 kg (RAV)	1187 kg	1102 kg	36 kg	6753 kg	6.4 kg	1206 kg	24 000 kg	200 000 kg
Copper (Cu)	7.2 kg (APV) 4.4 kg (RAV)	294 kg	273 kg	8.9 kg	1674 kg	1.6 kg	299 kg	112 000 kg	No data available
Chromium (Cr)	10.0 kg (APV) 6.2 kg (RAV)	412 kg	383 kg	12.5 kg	2344 kg	2.2 kg	419 kg	No data available	No data available
Zinc (Zn)	45.2 kg (APV) 27.8 kg (RAV)	1853 kg	1722 kg	56.1 kg	10 547 kg	10.0 kg	1883 kg	No data available	No data available
Nickel (Ni)	5.3 kg (APV) 3.2 kg (RAV)	216 kg	200 kg	6.5 kg	1228 kg	1.2 kg	219 kg	687 000 kg	No data available
Cadmium (Cd)	<0.6 kg (APV) < 0.4 kg (RAV)	<25 kg	<23 kg	<0.7 kg	<140 kg	<0.1 kg	<25 kg	2300 kg	7100 kg
Mercury (Hg)	<0.1 kg (APV) < 0.1 kg (RAV)	<4.9 kg	<4.6 kg	<0.1 kg	<28 kg	<0.03 kg	<5.0 kg	2100 kg	3400 kg

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Parameter	One gravity-based structure (GBS)	APV (41 foundations)	RAV (62 foundations)	1 km of cable (trench by dredging)	Cable routes (188 km)	1 km of cable (burying by jetting)	Cable routes (188 km)	Annual load entering the Baltic Sea through rivers	Annual load entering the Baltic Sea through rain
Arsenic (As)	<15 kg (APV) < 9.2 kg (RAV)	<613 kg	<569 kg	<19 kg	<3488 kg	<3.3 kg	<419 kg	No data available	No data available
PCB congeners	<0.006 g (APV) < 0.004 g (RAV)	<0.245 g	<0.228 g	<0.007 g	<1.395 g	<0.001 g	<0.249 g	260 000 g	715 000 g
PAH analytes (PAH group)	18.5 g (APV) 11.4 g (RAV)	760 g	706 g	23.0 g	4325 g	4.1 g	772 g	No data available	No data available
Available phosphorus (P)	1055 kg (APV) 648 kg (RAV)	43 244 kg	40 176 kg	1309 kg	246 107 kg	234 kg	43 948 kg	9 500 000 kg (P tot.)	163 000 000 kg
Nitrogen (N)	<239 kg (APV) <147 kg (RAV)	<9806 kg	<9110 kg	<297 kg	<55806 kg	<53 kg	<9965 kg	150 000 000 kg (N tot.)	5 700 000 kg

It has been assumed that all the sediments removed from the construction sites of foundations or support structures during seabed preparation will be left in the BC-Wind 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 and/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 (limit) phosphorus transfer from the sediment as this process takes place in anaerobic (reducing) conditions [6].

The sensitivity of sea waters was assessed to be 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 assessed to be negligible for sea waters and as low for seabed sediments.

Contamination of water and seabed sediments with oil derivatives during normal operation of vessels in the course of construction and at the time of 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) [201]. 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 m³, if any. 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 BC-Wind 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 to be insignificant.

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 to be 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 BC-Wind 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 m³ and up to approx. 200 m³.

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 has been found that a spill of 1.6 t (1.8 m³) of oil spreading over the surface of 1 km² 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 km² that has a film thickness of 0.05 µm [157].

Oil film formed on the water surface may cause:

- impeded exchange of gases, especially of oxygen, between the 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 BC-Wind 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. Approximately 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 involving 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 its contamination. None of the accidents that resulted in water contamination and required a clean-up occurred in the area of Polish Exclusive Economic Zone [170]. 2017 saw 8 confirmed oil spills less than 1 m³ in volume, one with a volume in the range of 1–10 m³ and one larger accident with a volume of 200 m³ [170].

In the south-eastern Baltic Sea area, in which the BC-Wind OWF Area analysed can be included, the risk of a collision with a spill of over 5000 tonnes was estimated to be 1 incident in 1060 years, whereas the areas under the greatest threat are found around the Wolin and Rügen islands as well as the Hel Peninsula.

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 m³. Assuming a breakdown or a collision of the largest vessels used at the construction phase of the BC-Wind OWF (during inspections, maintenance and emergency repairs) and the

destruction of the largest tanks of one vessel, no more than 200 m³ of fuel oil, 15 m³ of machine oil and approx. 2.5 m³ of hydraulic oil may be released from one vessel (in the worst-case scenario) [480].

In the event of a construction disaster at the OWF (a wind turbine falling over or a vessel colliding with the wind turbine or a substation), a leak of fuel oil (up to 100 m³), machine oil (up to 15 m³), hydraulic oil (up to 2.5 m³) or transformer oil (up to 80 m³) 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.

Moreover, a plan will be prepared for the BC-Wind OWF to prevent risks and contamination during the construction, operation 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. Such a plan (Oil Pollution Prevention Plan) in its preliminary version has been agreed with the Ministry of Infrastructure and its next version will be presented to the Maritime Office in Gdynia prior to submitting the application for the BC-Wind OWF construction permit.

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.

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. Among 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 [289] 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 to be 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 operation phase in the APV was assessed to be 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 will be generated on vessels and at the onshore site facilities (located in the port supporting the project implementation) – mainly municipal and other waste, not related to the construction process directly, as well as domestic sewage. 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 contaminants should rapidly disperse, which will stop them from contributing to a permanent environment deterioration in the project area. The sensitivity of sea waters and seabed sediments to this type of impact is assessed to be low.

The most important parameters affecting the level of this impact are the type and quantity of the waste or sewage released, the weather conditions as well as the type of rock material forming the seabed.

The sensitivity of both receptors is negligible.

The 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 to be 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 at 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 m³ each. It was assumed that during reloading activities, approx. 5 m³ 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^{-3}) 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 BC-Wind OWF, a detailed plan is prepared to prevent the risks and contamination generated during the construction, operation 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 in the case of this impact is moderate.

The 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 to be negligible for sea waters and low for seabed sediments.

6.1.1.3 Impact on climate, including greenhouse gas emissions and impacts relevant for adaptation to climate change, impact on atmospheric air (air quality)

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 BC-Wind OWF, an increased emission of pollutants into the atmosphere can be expected (including greenhouse gases), due to the increased traffic of vessels involved in the project implementation. 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 [141], 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 55.85 TWh during 25 years of operation, means the emission of from 0.33 to 1.92 million Mg of CO_2 . The larger of the quoted values refers to the case when a GBS with a high proportion of cement is used. Even in this case, the emissions will be at least 10 times lower than from the energy generated from other sources e.g. fired with hard coal or lignite (emission reduction of over 20 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, potential pollution will quickly dissipate. 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 offshore area

6.1.1.4.1.1 Phytobenthos

No impacts shall occur due to the absence of phytobenthos in the OWF Area before the beginning of the project implementation.

6.1.1.4.1.2 Macrozoobenthos

The works carried out on the seabed during the construction phase of the BC-Wind OWF, will cause the following impacts, affecting the condition of the macrozoobenthos inhabiting the area:

- disturbance of the seabed sediment structure;
- increased concentration of suspended solids in the water;
- sedimentation of suspended solids on the seabed;
- redistribution of pollutants from sediments into water.

The most important technical parameters of the OWF which are important from the point of view of the assessment of the project impact on macrozoobenthos during the construction phase are:

- the OWF Development Area;
- the foundations of wind turbines – type and number of foundations with the largest area covering the seabed;
- power cables – their length and the area of the seabed disturbed during cable laying.

These data are presented in Table 6.3.

Table 6.3. Compilation of key parameters of the BC-WIND OWF in the Applicant Proposed Variant (APV) in order to assess the impact on macrozoobenthos during the construction phase [Source: internal materials]

Parameter	Unit	APV
OWF area designated by the PSzW permit for the BC-Wind	km ²	90.94
BC-Wind Development Area	km ²	86.28
Maximum number of wind turbines	-	41
Maximum number of additional structures	-	6
Maximum diameter of the gravity-based structure (GBS)	m ²	60
Maximum area of the seabed occupied by the gravity-based structure (GBS)	m ²	2826
Maximum length of inner cable routes in the OWF	km	188
Cable trench width	m	7–11

The assessment of the wind turbines impact in the OWF Area (1 NM) during the construction phase was carried out separately for:

- the soft bottom macrozoobenthos;
- the hard bottom macrozoobenthos.

A separate assessment of the project impact on macrozoobenthos is the result of these two benthic fauna communities (from the soft and hard bottoms) differing in the taxonomic composition, abundance and biomass of their taxa. Consequently, they differ in significance and sensitivity regarding the various types of impact. The significance and sensitivity of the group of organisms assessed (the soft and hard bottom macrozoobenthos) together with the evaluation of the impact scale (nature of

interactions, type of interactions, spatial extent, time scope) influence the assessment of a given impact significance.

The macrozoobenthos significance is primarily its ecological (functional) significance, such as the food supply or habitat-forming role, and the impact of these organisms on the condition of marine environment elements such as sediments and the near-seabed water layer [518, 496, 288, 234, 465]. Moreover, the condition of macrozoobenthos as an environmental resource determines the ecological quality of marine areas, which can be assessed using appropriate indices [320].

The results of the inventory studies carried out in the BC-Wind OWF Area showed that the macrozoobenthos does not present a high value of the quality status of the two communities assessed here, nor is it unique in terms of its qualitative and quantitative composition compared to the macrozoobenthos inhabiting a similar depth range in the open waters of the Southern Baltic within the PMA.

The soft bottom macrozoobenthos complex inhabits the sandy and gravelly seabed with the greatest area within the planned project area (>95% of the surface) and is characterised by moderate ecological quality status. The complex is made up of species common and characteristic of this type of seabed in the open waters of the Southern Baltic, while their biomass is dominated by organisms such as the mussel *Limecola balthica* and the *Marenzelleria* sp. polychaetes, tolerant to environmental degradation and changes in organic matter content in the sediment. The significance of the soft bottom macrozoobenthos complex in the area of the planned project for the functioning of the ecosystem was considered to be low.

The hard bottom macrozoobenthos complex inhabiting the surface of boulders and stones, found in the western and southern parts of the planned OWF (1 NM), occupies up to 5% of its area. The valorisation of this type of habitat which had a good ecological status demonstrated its higher nature value. This group of organisms includes mainly the habitat-forming bay mussels *Mytilus trossulus*, which play an important role as a food supply and the accompanying fauna, such as crustaceans, bryozoans, hydrozoans and polychaetes. On the other hand, the range of the occurrence of this complex is limited to the small area of the boulder area occupied, located at the depth range of 28.3–39.5 m. The significance of the hard bottom complex in the BC-Wind OWF Area was defined as high.

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 sensitivity of macrozoobenthos will differ in the subsequent stages of the project. Table 6.4 presents the definitions of macrozoobenthos sensitivity on a five-point scale.

Table 6.4. Macrozoobenthos sensitivity to the OWF impact [Source: internal materials based on [170, 35, 33]]

Sensitivity	Description
Irrelevant	The influence of the stressor has a very little impact on the changes in the structure and functioning of the organism complex
Low	The survival of some benthic species may be limited; the ability to restore the benthic complex and return to its original state after the impact factor has ceased to exist will happen within a year
Moderate	Some species in the benthic complex will be destroyed and the survival of the remainder may be limited; after the impact factor ceases to exist, the ability to restore the quantitative structure of the longest-living species in this complex may take up to several years

Sensitivity	Description
High	Most species in the benthic complex will be destroyed and the survival of the remainder may be limited; the ability to restore the benthos complex may be possible many years after the impact factor has ceased to exist, however, the complex may have a different qualitative structure than before the period in which the environment changed as a result of the project implementation
Very high	The benthic complex will be destroyed under the impact of the stressor and it will not be possible to return it to its original state

The disturbance of the seabed sediment structure is the most negative type of impact on macrozoobenthos of all those occurring during the OWF construction phase. Excavating material for foundations and/or support structures and scour protection layers, levelling the seabed, burying power cables in the seabed, dumping excavated material in the storage area, as well as the operation of jack-up type construction vessels are the factors with the greatest impact on macrozoobenthos species inhabiting the surface of sandy and gravelly sediments as well as the stony seabed because of their inability to move inside the sediment but also on the organisms living in the sediment mainly in its upper layer [51, 41]. These activities lead primarily to the physical destruction of natural macrozoobenthos communities, and to a lesser extent to an increased macrozoobenthos mortality when invertebrates are brought to the surface of the sediment, as a result of which they will undergo physical elimination or pressure from predators, mainly fish [221, 516]. Only mobile macrozoobenthos species, i.e. crustaceans occurring in low numbers both in the soft and hard bottom macrozoobenthos complexes in the BC-Wind OWF Area, will avoid adverse environmental conditions by escaping [260]. The destruction of macrozoobenthos organisms in the BC-Wind OWF Area until their population is restored will contribute, among others, to the loss of food supply, mainly for benthivorous fish. On the other hand, due to the spatial scale of this impact and the ability of fish to actively forage for food, it can be assumed that the reduction in food resources will not be significant for benthivorous fish (Appendix 1 to the EIA Report). Then, the benthos species that play an important role in bioturbation and bioirrigation, and thus, the transport of oxygen and organic matter into the sediment, important in terms of microbiological decomposition and mineralisation processes, will be destroyed [41]. On the other hand, the planned BC-Wind OWF Area is not a region of numerous occurrence of diving benthivorous birds (such as long-tailed ducks and velvet scoters) that feed on macrozoobenthos, mainly mussels, because there are great depths in this area that make it difficult for sea ducks to access food. Therefore, the abundance of the long-tailed duck and velvet scoter in the BC-Wind OWF Area was low. With a considerable depth of the sea area, and for the BC-Wind OWF Area it ranges between 28–65 m, it is more difficult for benthivorous birds to reach their food because they incur high energy costs when diving. For sea ducks, the most energy-efficient is feeding in shallower (up to 20–25 m) water bodies (Appendix 1 to the EIA Report). For this reason, the depletion of the food supply by the destruction of macrozoobenthic organisms in the investment area is not very significant for diving benthivorous birds for which this area is not an important feeding ground.

In the Applicant proposed variant (APV) it should be assumed that among such types of foundations and/or supporting structures for wind turbines, such as large diameter piles, lattice foundations, tripods, floating supporting structures and gravity-based structures (GBS), the latter will occupy the largest seabed surface. Thus, the installation of these foundations will have the most unfavourable impact on macrozoobenthos. The total area of the OWF designated in the PSzW, is 90.94 km², of which the Development Area will not exceed 86.28 km². The physical destruction of macrozoobenthos will take place on the seabed surface disturbed by the installation of 41 wind turbine foundations of the

GBS type, across 0.12 km². Much greater destruction of macrozoobenthos will occur along the route of internal power cables, i.e. it will cover a seabed area of 2.06 km², assuming the length of cable routes inside the OWF – 188 km – and the maximum width of the cable trench – 11 m prepared using a dredger. In this case, the ground is removed and the cable is placed in a trench, which is then backfilled with the same amount of material. As a result, a significant amount of ground is disturbed. If the jetting method was used, the area of the damaged habitats along the cable route would be slightly smaller. In total, the destruction of macrozoobenthos complexes, and thus, the potential feeding grounds for fish and benthivorous birds in the BC-Wind OWF Area, will occur over an area of 2.18 km², which is about 2.5% of the Development Area [Table 6.3].

The sensitivity of the soft bottom macrozoobenthos complex in the BC-Wind OWF Area to this impact is moderate. Despite the fact that the abundance structure of the population of this organism complex is dominated by *Pygospio elegans* polychaetes, the ability to restore the entire complex and return to its original state after the impact factor ceases to exist will last from one year up to several years. This is due to the length of time it will take to restore the quantitative structure of the longest living species in this group, such as the mussels *Mya arenaria*, *Limecola balthica* and *Mytilus trossulus* [500, 518, 340]. It only applies to areas with no permanent mechanical destruction of the benthos underneath the foundations and/or supporting structures of wind turbines.

Similarly, the sensitivity of the hard bottom macrozoobenthos complex, in which the *Mytilus trossulus* mussel constitutes a group of absolutely constant taxa dominant in abundance and biomass, the sensitivity to the disturbance of the seabed sediments will be moderate.

Impact assessment will be identical for the soft bottom and the hard bottom macrozoobenthos complex. In both cases, with a moderate sensitivity of individual complexes and a moderate scale of the impact, taking into account the medium-term scope of the seabed sediment structure disturbance of a local nature, the significance of the impact for the BC-Wind OWF Area was assessed to be low [Table 6.5, Table 6.6]

The increase in the concentration of suspended solids in the water is another type of impact on the macrozoobenthos in the BC-Wind OWF Area during the construction phase. During dredging works and during the laying and burying of power cables in the seabed, due to the disturbance of the seabed sediment structure, the sediment from the seabed is lifted and dissipates in the water as suspended solids [249, 516]. The value of suspended solids concentration depends on the velocity of sea currents, their direction, turbulence processes, as well as the size of the seabed sediment fraction. Higher suspended solids concentration and longer exposure time of mineral and organic particles in the water cause adverse effects on the condition of benthic fauna [306, 176]. 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 may feed less effectively. At a suspension concentration above 250 mg·l⁻¹, the growth of macrozoobenthic organisms is limited [119], and it may even increase the mortality of mussels, which is a result of the clogging effect [297, 292]. Despite the fact that macro-invertebrates are naturally adapted to high concentrations of suspended solids, such as the ones occurring during storms (they can survive a month in conditions of very high suspended solids concentration up to 100 mg·l⁻¹) [33, 292], the Baltic Sea mussels are physiologically less adapted to filtering the suspended solids in high concentrations, because they are not prepared to living in conditions of strong currents or tides [119, 75].

The model analyses of the dispersion of suspended solids in the BC-Wind OWF Area, with depths in the range of 27.7–65.2 m, show that the least favourable for macrozoobenthos (mainly the hard bottom complex composed of bay mussel aggregation) in terms of the impact of suspended solids introduced into the marine environment will be the installation of gravity base structures (GBS) in cohesive soils by jetting, both in the APV and the RAV (Appendix 2 to the EIA Report). It should be emphasised that, in the seabed surface layers of the BC-Wind OWF Area considered, sandy sediments i.e. non-cohesive sediments prevail. The analyses conducted show that, the greatest impact ranges of suspended solids may occur at moderate winds of constant direction, whereas the highest concentrations of suspended solids will be generated by currents with the lowest velocities (around several $\text{cm}\cdot\text{s}^{-1}$) and of circulating nature. Moreover, the suspended solids concentrations during preparatory works related to foundation laying reach values higher than the concentrations occurring during the laying of power cables. Higher concentrations of suspended solids (from 30 to over $100\text{ mg}\cdot\text{l}^{-1}$) have a local range in relation to the location of dredging works, and their impact range does not exceed a distance of 1000 m. This impact will be short-term, because the propagation of suspended solids with an increased concentration in the worst-case scenario does not last longer than 62 hours from the moment of the commencement of works in the seabed on a single foundation (Appendix 2 to the EIA Report).

The sensitivity of the macrozoobenthos complex inhabiting the soft bottom of the BC-Wind OWF Area to this impact is negligible. Since the organisms inhabiting the interior of the sediment, such as polychaetes and oligochaetes, are predominant in the abundance structure of this complex of organisms, the influence of the stressor, such as the increase in the concentration of suspended solids in the water, does not forecast significant changes in the structure and functioning of this complex of organisms.

On the other hand, the hard bottom macrozoobenthos complex consisting primarily of filtrating organisms, i.e. the *Mytilus trossulus* bivalve will be characterised by low sensitivity, since it cannot be excluded that with the increase in suspended solids concentration in water, the functioning of the filtering system and, therefore, the survival of some of the most exposed individuals will be reduced. However, it should be noted that the impact will be of a short-term character and, in terms of reaching the maximum values of suspended solids concentration in water, it will be comparable to those that may occur naturally during storms ($100\text{ mg}\cdot\text{l}^{-1}$).

Taking into account the sensitivity of individual macrozoobenthos complexes, i.e. irrelevant for the soft bottom macrozoobenthos and low for the hard bottom macrozoobenthos and the scale of the impact described estimated to be irrelevant for the soft bottom macrozoobenthos and low for the hard bottom macrozoobenthos, the significance of the increased suspended solids concentration in the BC-Wind OWF Area was evaluated as negligible for the macrozoobenthos [Table 6.5, Table 6.6].

Sedimentation of suspended solids on the seabed causes the benthic habitat to be covered with an additional layer of sediment. Furthermore, suspended solid particles that fall onto the seabed may be subject to erosion by being transported in the re-suspension process which results from the hydrodynamic conditions in the sea area [516]. Numerous macrozoobenthos organisms are naturally adapted to living in sediment disturbance and precipitation conditions (as a result of storms or tide cycles) causing them to be covered. The response to such an adverse impact is the mechanical capability of some of the macroinvertebrates to move in the sediment towards the oxygenated above-seabed layer or the physiological resistance to hypoxic or even anoxic conditions [292, 174, 33]. Vagile

infauna species (e.g. polychaetes and oligochaetes) are more tolerant to being covered with an additional sediment layer, since they are able to move through a layer of up to 10 cm, although that depends on the sediment grain fraction and the duration of the negative impact. On the other hand, the species more sensitive to this impact are those of the sedentary epifauna and macrozoobenthos larvae, since when covered by an additional layer of sediment, these organisms will have limited capacity to move and reach the sediment surface which is an essential condition for respiration and feeding. Thus, the mussels will try to move their siphons above the sediment layer [273, 176, 292, 140]. The Baltic clam (*Limecola balthica*) is one of the macrozoobenthos species the most resistant to the impact described, since it may survive for a month with the sediment layer increase by 7–20 cm [461, 119]. On the other hand, the maximum tolerance of the sand gaper *Mya arenaria* to sedimentation of sand is 5 cm/month [119]. The most important factor influencing the survival of benthic fauna in these conditions is access to oxygen dissolved in water, which can diffuse into the sediment (from 1 to 2 mm) [174]. Typically, the macrozoobenthos is quite tolerant to being covered by an additional layer, up to 0.2–0.3 m thick, of suspended solids undergoing sedimentation, especially if this layer is composed of a fine sand fraction [119, 292, 140]. However, the long duration of the negative impact in the form of an additional sediment layer covering all benthic species contributes to their increased mortality [176].

The results of modelling regarding the determination of the thickness and spatial distribution of sediments on the seabed caused in the process of sedimentation of suspended solids generated as a result of preparatory works for the foundation and/or supporting structure and during the laying of cables indicate that the thickness of the newly-formed sediment is considerably smaller as a result of cable laying than as a result of the works related to the laying of the foundations of supporting structures. The greatest thickness of the newly-formed sediments in the worst-case scenarios at a distance of 100 m from the work site, do not exceed the value of 25 mm in the case of the works related to the preparation for the foundation, 7 mm in the case of power and telecommunication cable laying using the jetting method, and 21 mm in the case of laying power and telecommunication cables using the mass flow excavation method. The thickness of the newly-formed sediments (from suspended solids sedimentation) at a distance of 1000 m from the site of the work carried out do not exceed 4 mm (Appendix 2 to the EIA Report). Moreover, it should be emphasised that the assessment of the quality of water in the BC-Wind OWF Area based on the oxygen content in the near-seabed layer in the summer period (July and August) indicates good condition (no oxygen deficit) (Appendix 1 to the EIA Report).

It was determined that the sensitivity of the soft bottom macrozoobenthos complex in the BC-Wind OWF Area on the sedimentation of suspended solids at the seabed is low. This complex includes the representatives of the epibenthos, among others molluscs, primarily *Limecola balthica* but also *Mya arenaria* and *Mytilus trossulus*. These are organisms which, when covered by an additional layer of sediment, may have an obstructed access to the oxygen dissolved in the water and may reduce their filtration process. Also, the infauna may be, in short-term, affected by the arising anoxic conditions.

On the other hand, in the case of the hard bottom macrozoobenthos complex, the *Mytilus trossulus* bivalve may be negatively affected due to the inhibition of the filtration process. The sensitivity of this complex was also assessed to be small.

Due to the fact that within the entire BC-Wind OWF Area, both in the APV and the RAV, the project works would generate a sediment layer of 0.8 mm, which is a relatively small value, that will mostly comprise the fine sand fraction and given the beneficial oxygen condition in the above-seabed layer,

the scale of the negative impact on the macrozoobenthos will be low. Despite the fact that the sedimentation of suspended solids on the seabed may temporarily reduce the benthos resources and, therefore, reduce the food supply for the fish and seabirds in the affected area, the maximum thickness of the sediment layer, apart from the areas closest to the foundations or cables being laid, will not exceed the lethal values specified in the literature for all macrozoobenthos taxa identified within the project area and, therefore, this impact will be short-term and reversible.

Taking into account the low sensitivity of both macrozoobenthos complexes evaluated and the scale of the impact described assessed to be low, the significance of the suspended solids sedimentation on the seabed of the BC-Wind OWF Area was assessed to be negligible for both the soft and hard bottom macrozoobenthos complexes [Table 6.5, Table 6.6].

Redistribution of pollutants from sediment into water is the last of the factors that adversely impact the macrozoobenthos. As a result of disturbing seabed sediments during the installation works, burying of power cables or anchoring of vessels, benthic fauna will be exposed to increased concentrations of pollutants, e.g. heavy metals, toxic organic compounds: polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB) and tributyltin (TBT) transferred from the sediments into water as a result of chemical and biochemical processes [48, 98, 466]. Accumulation of toxic substances leads to reproductive function disorders, diseases and increased mortality of macrozoobenthos, resulting in the reduction of population numbers and biodiversity of the benthic fauna that will be dominated by opportunistic species. Especially the filtering organisms, such as mussels are susceptible to this impact as they develop cancer due to the accumulation of toxic substances in soft tissues [434, 133, 150, 180, 146].

The impact on the macrozoobenthos was indirectly determined using surveys of the physical and chemical condition of seabed sediments in the BC-Wind OWF Area with regard to their contamination. As a result of the surveys conducted, it was concluded that the seabed surface sediments analysed belong to inorganic deposits with the organic matter content (expressed as loss on ignition [LOI]) below 4%. They were characterised by a low nutrient content. The concentrations of persistent organic pollutants (i.e. PAHs, PCBs and TBT) and toxic substances such as metals or mineral oils in the survey area were low and did not deviate substantially from the data from literature regarding sandy seabed sediments of the Southern Baltic. The sediments tested were also characterised by low concentrations of the radioactive element ¹³⁷Cs, typical for sandy sediments. The concentration values obtained for labile metal forms responsible, among others, for their toxicity, bioavailability or accumulation in seabed sediments of the OWF Area and the PAH and PCB values, compared to normative values specified in the Regulation of the Minister of the Environment of 11 May 2015 on the recovery of waste outside the installations and facilities (Journal of Laws of 2015, item 796) were low in the seabed sediments tested and the sediments were not contaminated with compounds of those groups. Also, the concentrations of TBT and the products of its decay (DBT and MBT) obtained for the seabed sediments from the BC-Wind OWF Area were typical for the sandy sediments of the Southern Baltic (Appendix 1 to the EIA Report).

Due to the possibility of redistribution of pollutants from sediment into water, the sensitivity of both the soft and hard bottom macrozoobenthos complex representatives to this impact will be irrelevant. It is expected that this phenomenon has very little impact on the changes in the structure and functioning of both macrozoobenthos complexes, taking into account the results according to which the concentrations of substances that are toxic and harmful to the benthic fauna in the survey area

were low and the processes related to the release of labile metal forms, nutrients (nitrogen and phosphorus compounds) and PAHs and PCBs will occur with low intensity in the entire BC-Wind OWF Area.

Given the irrelevant sensitivity of both macrozoobenthos complexes assessed to that impact and the scale of the described impact assessed to be irrelevant, the importance of redistribution of pollutants from sediment into water in the BC-Wind OWF Area will be a negligible impact, for both the soft and hard bottom macrozoobenthos complexes [Table 6.5, Table 6.6].

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Table 6.5. Assessment of the impact of wind turbines on the soft bottom macrozoobenthos in the BC-Wind OWF Area (1 NM) during the construction phase [Source: internal materials]

Impact	Characteristic of the soft bottom macrozoobenthos complex		Scale (size) of impact					Impact significance
	Significance	Sensitivity	Character	Type	Spatial range	Time span	Size	
Disturbance of the seabed sediment structure	Low	Moderate	Negative	Direct	Local	Medium-term	Moderate	Low
Increase in the content of suspended solids in the water	Low	Irrelevant	Negative	Direct	Local	Short-term Temporary	Irrelevant	Negligible
Sedimentation of suspended solids on the seabed	Low	Low	Negative	Direct	Local	Short-term Temporary	Low	Negligible
Redistribution of pollutants from the sediment into the water	Low	Irrelevant	Negative	Direct	Local	Short-term	Irrelevant	Negligible

Table 6.6. Assessment of the impact of wind turbines on the hard bottom macrozoobenthos in the BC-Wind OWF Area (1 NM) during the construction phase [Source: internal materials]

Impact	Characteristics of the hard bottom macrozoobenthos complex		Scale (size) of impact					Impact significance
	Significance	Sensitivity	Character	Type	Spatial range	Time span	Size	
Disturbance of the seabed sediment structure	High	Moderate	Negative	Direct	Local	Medium-term	Moderate	Low
Increase in the content of suspended solids in the water	High	Low	Negative	Direct	Local	Short-term Temporary	Low	Negligible
Sedimentation of suspended solids on the seabed	High	Low	Negative	Direct	Local	Short-term Temporary	Low	Negligible
Redistribution of pollutants from the sediment into the water	High	Irrelevant	Negative	Direct	Local	Short-term	Irrelevant	Negligible

The analysis of the four main factors of pressure on the soft and hard bottom macrozoobenthos during the construction phase of the BC-Wind OWF revealed that these impacts were assessed to be of low significance in the event of disturbance of seabed sediments and negligible for all the remaining impacts during this phase of the project [Figure 3.6, Table 6.5, Table 6.6].

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 acoustic interference in the construction phase is the driving of foundation elements of the wind turbines into the seabed (piling). The noise related to this process may negatively affect marine organisms [325]. According to Popper and Hastings [348], piling is the only noise source, apart from underwater explosions, that can result in fish deaths.

The sound generated during piling is of pulsating nature, characterised by short duration (<1 s) and a band width between 100 and 1000 Hz, however, most of its energy falls within the range of up to 500 Hz [87]. The level of noise emitted during piling depends mainly on the technical parameters of the process (pile diameter, technology of pile driving, force and frequency of pile driver strikes). Some of the technological requirements are, in turn, dependent on the environmental conditions (depth, type of sediment).

The values of sound level related to piling are usually expressed in two categories of units.

The first category refers to the sound pressure level and represents the maximum/minimum value of pressure recorded for a single pulse [SPL_{peak}] or the value corresponding to the range between the maximum values of the over- and underpressure [$SPL_{peak-peak}$]. The sound intensity expressed in such units is correlated with the behavioural reactions.

The second category of units refers to the exposure to sound and represents the cumulated sound energy for a single pulse (SEL_{ss}) or for several pulses (SEL_{cum}). This parameter is correlated with physical damages (tissue damage, PTS and TTS).

Sound exposure level (SEL) during piling depends on the pile diameter and can reach from approx. 230 dB re: 1 μPa^2s (pile diameter of 1.5 m) [448] to nearly 260 dB re: 1 μPa^2ss (pile diameter of 4.5 m) [325] in the direct vicinity of the source. The values measured at a distance of 750 m from the sound source, available in the literature, in the case of SEL_{ss} range from 157 dB re: 1 μPa (pile diameter of 0.9 m) up to 180 dB re: 1 μPa (pile diameter of 5 m); whereas, for SPL_{peak} they fall between 183 dB re: 1 μPa^2s (pile diameter of 0.9 m) and 200 dB re: 1 μPa^2s (pile diameter of 4 m) [8].

Many authors dealing with the issues of the impact of acoustic stimuli on fish, underline the great difficulties in determining the noise levels at which particular effects occur and which could be used as universal values for ichthyofauna. This stems, first of all, from the differences in the anatomical structure of the hearing system, mainly the morphology of the swim bladder [8, 349]. An additional

handicap is the fact that the majority of experiments are carried out in enclosed tanks, and translating their results to natural environment conditions may be vitiated by a major error.

The latest available recommendation for sound limits that cause physical injury to fish was provided by Andersson *et al.* [8] on the basis of experimental data. The minimum sound values at which the physical injury to internal organs or death occurs are presented in Table 6.7.

Table 6.7. Recommendations for establishing thresholds for the noise generated during piling that can cause physical injury to fish [Source: internal materials based on Andersson *et al.* [8]]

Unit	Adult fish and juvenile stages	Roe and larvae
SPL _{peak}	207 dB re 1 μ Pa	217 dB re 1 μ Pa
SEL _{ss}	174 dB re 1 μ Pa ² s	187 dB re 1 μ Pa ² s
SEL _{cum} *	204 dB re 1 μ Pa ² s	207 dB re 1 μ Pa ² s

*Cumulative exposure value corresponding to 960 pulses or 24 minutes of exposure

It should be underlined that the SEL_{cum} value of 204 dB re: 1 μ Pa²s is a conservative value. The occurrence of irreversible body injuries was observed at higher values of this parameter (207 dB re: 1 μ Pa²s), whereas the SEL_{cum} value of 204 dB caused reversible injuries that may subside in favourable conditions (no predation pressure, good food availability and favourable environmental parameters) [344]. At the same time, Andersson *et al.* [8] underline that the value provided is the effect of the sound exposure lasting 24 minutes. During this time, a fish may migrate away from the area of increased exposure: for both cod and herring this may be a distance exceeding 1000 m.

Approximate sound levels at which individual impacts occur are provided by Popper *et al.* [350]. In their deliberations, these authors also consider the dependence of the impact effect on the structure of the fish hearing system and provide values at which a temporary threshold shift of hearing may occur (TTS) [Table 6.8]. Fish without a swim bladder (e.g. adult flatfish, common seasnail, round goby) or fish in which the swim bladder is far away from the ear (e.g. salmon) are only able to perceive the movement of water particles but not pressure changes. This is due to the narrow range of frequencies heard (usually up to approx. 500 Hz) and the higher hearing threshold. In the case of fish with a swim bladder located close to or directly connected to the ear (e.g. cod and clupeids, sand goby), the hearing threshold is lower and the range of frequencies perceived can reach 3000–4000 Hz [349].

Table 6.8. Impact of a pile driver sound on ichthyofauna, taking into account morphology and developmental stage. For impact effects for which it was impossible to determine the sound level, the relative risk (low, moderate, high) was determined depending on the distance from the source of the sound: (C) close – several dozen meters, (M) moderately far – several hundred meters, (F) far – several thousand meters. Units for peak values: dB re 1 μ Pa and for the cumulative SEL value: dB re 1 μ Pa²s [Source: internal materials based on Popper *et al.* [350]]

Type of organism	Mortality and potential lethal damage	Renewable damage	Temporary Threshold Shift (TTS)	Masking	Behavioural changes
Fish without swim bladder (detection of molecule movement), e.g. flatfish	>219 dB SEL _{cum} >213 dB _{peak}	>216 dB SEL _{cum} >213 dB _{peak}	>186 dB SEL _{cum}	(C) moderate (M) low (F) low	(C) high (M) moderate (F) low
Fish with swim bladder unconnected to the inner ear (detection of molecule	210 dB SEL _{cum} >207 dB _{peak}	203 dB SEL _{cum} >207 dB _{peak}	>186 dB SEL _{cum}	(C) moderate (M) low (F) low	(C) high (M) moderate (F) low

Type of organism	Mortality and potential lethal damage	Renewable damage	Temporary Threshold Shift (TTS)	Masking	Behavioural changes
movement), e.g. Atlantic salmon					
Fish with a swim bladder connected to the inner ear (sound pressure detection), e.g. Atlantic cod, herring	207 dB SEL _{cum} >207 dB _{peak}	203 dB SEL _{cum} >207 dB _{peak}	186 dB SEL _{cum}	(C) high (M) high (F) moderate	(C) high (M) high (F) moderate
Roe and larvae	>210 dB SEL _{cum} >207 dB _{peak}	(C) moderate (M) low (F) low	(C) moderate (M) low (F) low	(C) moderate (M) low (F) low	(C) moderate (M) low (F) low

Data on cod indicate that a behavioural response can be expected from the level of 140–160 dB re: 1 μ Pa SPL_{peak} [295]. In the case of sprat (sound recording range similar to herring), changes in behaviour were observed at SPL (peak-peak) levels of 163 dB re: 1 μ Pa and SEL_{ss} 135 dB re 1 μ Pa²s [162]. It may be assumed that the basic reaction of fish will involve abandoning the area in which the increased level of noise is present. According to Hammar *et al.* [160], at the project construction stage in the vicinity of the spawning grounds, the spawning of cod may be significantly disrupted. The authors recommend the piling and submarine cable laying to be suspended in the spawning period of this species. However, some studies indicate that fish may remain in the area subject to such impact, if this conditions their survival or success of their reproduction processes [490, 332]. A similar effect was observed during the feeding migrations of herring, during which the response to sound was observed at higher noise levels than in other circumstances. The American National Marine Fisheries Service assumes 150 dB re: 1 μ Pa (rms) (unit based on the root mean square of energy per pulse) as the limit from which the behavioural changes in fish can occur. However, the adoption of a criterion based on a single value, which does not take into consideration the varied sensitivity to sound of different fish species and is not based on survey results, is highly questionable [8, 349].

Andersson *et al.* [8] believe that the data available do not support the determination of noise levels that are universal across ichthyofauna, at which temporary threshold shifts in hearing (TTS) as well as masking effects and behavioural changes occur. This stems from the interspecies differences in response to sound frequency and intensity.

Other sources of noise emissions at the construction stage, will be the burying of cables connecting the wind turbines and the cables connecting the connection infrastructure. Very little information is available in the literature on the noise emitted during this type of work. According to Nedwell and Howell [302], the noise level during the construction of trenches for cables was 178 dB re: 1 μ Pa²s at a distance of 1 meter from the sound source. A higher value of 187 dB re: 1 μ Pa²s, is given by Taormina *et al.* [438].

In majority of studies [276, 323, 324, 438], it is assumed that the impact of this factor on the marine organisms will be relatively small. However, at the same time, most authors emphasise that a final assessment of the significance of this factor requires the acquisition of more data on noise levels generated during cable laying.

An increased vessel traffic can be expected during the construction phase of the project. The noise generated by vessels reaches, depending on the size and speed of the vessel, from 160 to 190 μ Pa²s

[325] and appears to pose less of a threat than the sound sources directly associated with construction works.

The numerical model of noise propagation during piling predicts that the range of impact causing behavioural responses shall equal 23 km at maximum for fish without a swim bladder and 59 km for fish with a swim bladder. In the event of the noise and vibrations causing TTS, the range shall not exceed 0.1 km for a single strike and 8 km for the SEL accumulated over 1 hour [Table 6.9].

Table 6.9. Summary of distance ranges to threshold values for fish, obtained for the BC-Wind OWF with an application of an NRS [Source: internal materials]

Effect of factor impact		SEL limit (dB re 1 $\mu\text{Pa}^2\text{s}$)	Impact range	
			Average distance [km]	Maximum distance [km]
Fish without a swim bladders	Behavioural response	142	14	23
	TTS (single strike)	186	0.1	0.1
	TTS (1h cumulative SEL)	186	6.5	8.0
	PTS (single strike)	216	0.1	0.1
	PTS (1h cumulative SEL)	216	0.1	0.1
Fish with a swim bladder	Behavioural response	135	24	59
	TTS (single strike)	186	0.1	0.1
	TTS (1h cumulative SEL)	186	6.5	8.0
	PTS (single strike)	203	0.1	0.1
	PTS (1h cumulative SEL)	203	0.6	0.7

In addition, the use of the soft-start procedure before starting works, which aims to scare the ichthyofauna away from the area subject to impact, should additionally reduce the impact causing the TTS. For this reason, the analysis does not include the possibility of increased mortality in ichthyofauna or tissue damage.

Because of the prevailing hydrological conditions, the OWF Area is not a spawning ground of cod or 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 impact of noise and vibration on adult fish will be negative, direct, short-term and reaching beyond the BC-Wind OWF Area (regional).

The sensitivity of cod, herring, sprat and sand goby to the impact was assessed to be very high, while in the case of European flounder and common seasnail – to be high.

The significance of the impact was assessed to be moderate for all the fish species examined. As far as the protected fish are concerned, during the surveys, only the larval stages occurred, for which the impact will be local.

Increase in suspended solids content

The increase in suspended solids concentration in seawater occurs during the construction and decommissioning of the project. It occurs during the construction of the foundation of wind turbines (mainly gravity-based structures) and excavations for power cables as well as during decommissioning

and removal of the OWF elements. The significance of its impact on fish will depend both on physical factors such as sediment characteristics (grain size, mineral composition, adsorption and absorption capacity), salinity, temperature and oxygen concentration of the seawater [114], as well as biotic factors related to the condition of fish, their developmental stage, method of reproduction and a life mode. The intensity of the impact is also strictly related to the concentration of suspended solids as well as the duration of exposure and range of increased level of this factor on ichthyofauna [306]. Both parameters are closely related to the sediment type, current directions, seabed morphology and hydrodynamic conditions in the project area. 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 impact of increased concentration of suspended solids on ichthyofauna may cause a series of negative effects, such as avoidance response, reduction of the growth rate and reproductive efficiency. It may also cause an increase in susceptibility to disease and even fish mortality.

The sensitivity to the impact of this factor depends on the developmental stage of the organism. In the case of early developmental stages (eggs and larvae), adverse effects may occur at concentrations of several milligrams per dm^3 , whereas the increased mortality of juvenile and adult fish is observed at concentrations of several grams per dm^3 [114], although some sources provide lower values that can cause such effects (above $100 \text{ mg} \cdot \text{dm}^{-3}$, Hansson 1995). Higher susceptibility of the earliest developmental stages to the impact results from their high rate of metabolism and the related high demand for oxygen [18, 330]. Particles of suspended solids entering the gills of larvae may impede respiration and contribute to the increase in their mortality [152, 160].

The experimental surveys demonstrated the slowdown of herring larvae growth at suspended solids concentration exceeding $540 \text{ mg} \cdot \text{dm}^{-3}$, whereas at a concentration of $19 \text{ g} \cdot \text{dm}^{-3}$, mortality of 100% was recorded [287]. In similar studies [306] involving arctic grayling, Newcombe and MacDonald indicated a slight increase in mortality (6%) at concentrations of $25 \text{ mg} \cdot \text{dm}^{-3}$, while a 4-day exposure of larvae to suspended solids concentration exceeding $230 \text{ mg} \cdot \text{dm}^{-3}$ increased mortality up to 50%. Westerberg *et al.* [499] found a very high sensitivity of the early developmental stages of cod (larvae with a yolk sac) for which increased mortality was observed already at values of $10 \text{ mg} \cdot \text{dm}^{-3}$.

High concentration of suspended solids may also limit visibility. Taking into consideration the larvae minimal ability to see (in many cases limited to a distance equal to their body length) [44] this may negatively affect the efficiency of noticing and obtaining food. According to Utne-Palm [474], high turbidity (80 JTU) negatively affected the ability of herring larvae to obtain food. On the other hand, the limitation of visibility may indirectly positively affect the survival of larvae by reducing the predation pressure [149].

The increased sensitivity of larvae in comparison to adult fish results also from a significantly lower mobility of such developmental stages, and consequently, a limited possibility to abandon the area subject to the impact.

A negative impact of increased suspended solids concentrations on fish roe was also observed. This involves mainly the limitation of gas and metabolite exchanges caused by the suspended solids particles adhering to the egg membrane [70, 15]. According to Rönnbäck and Westerberg [374], a significant increase in mortality of cod eggs at suspended solids concentrations exceeding $100 \text{ mg} \cdot \text{dm}^{-3}$ was observed. Deposition of suspended particles on the surface of pelagic roe may also result in its falling to lower water layers or to the seabed. This may be connected to the exposure to

worse oxygen conditions, as well as the exposure to predation by benthic organisms as well as mechanical and physiological stresses.

This has been confirmed by the studies of Rönnbäck and Westerberg [374], which demonstrate the correlation between the suspended solids concentration in the water depth and the exposure time of the cod roe as well as the rate at which it falls to the seabed. These authors have reported that this process can occur already at a suspension concentration of $5 \text{ mg}\cdot\text{dm}^{-3}$ maintained at this level for 4 days.

The impact of increased concentrations of suspended solids on demersal roe is probably less intensive than in the case of pelagic roe. Information on the harmful impact of this factor concern mainly freshwater fish or fish spawning in freshwater, and a decrease in hatching success was observed only at relatively high concentrations ($500\text{--}1000 \text{ mg}\cdot\text{dm}^{-3}$) [18].

On the other hand, no distinct impact of an increased, even up to $7000 \text{ mg}\cdot\text{dm}^{-3}$, suspended solids concentration in the water was observed in relation to the hatching of herring eggs [287]. Also, Kiørboe *et al.* [214] have not observed a negative impact of the increased suspended solids concentrations ($300\text{--}500 \text{ mg}\cdot\text{dm}^{-3}$) on the development of roe. However, these authors emphasise that the negative impact of this factor may be much greater in bad oxygen conditions. The increase in suspended solids quantity may also indirectly affect the herring reproductive success. De Groot [152] 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 concentration on demersal roe, the harmfulness of covering the grains deposited on the sediment surface by a layer of particles undergoing sedimentation cannot be excluded.

Due to the possibility of active avoidance of areas with high suspended solids concentration by adult developmental stages of fish, sublethal rather than lethal impacts should be expected [216]. The suspended solids concentration values at which the effect of contaminated areas avoidance is caused differ depending on the species and the development stage of fish. For juvenile herrings, it was observed at $12 \text{ mg}\cdot\text{dm}^{-3}$ [287], whereas for adult fish the reaction was observed at a slightly lower level – $10 \text{ mg}\cdot\text{dm}^{-3}$ [190]. Lower values of $3 \text{ mg}\cdot\text{dm}^{-3}$, causing the same effect, were observed in experimental studies by Westerberg *et al.* [499].

On the other hand, the studies conducted by Hammar *et al.* [158] during the construction of the Lillgrund OWF located in the Danish Straits did not confirm a significant impact of the suspended solids concentrations reaching up to $10 \text{ mg}\cdot\text{dm}^{-3}$ on the distribution of fish in the project area.

A reverse reaction to avoidance responses is also possible for the species preferring an increased level of turbidity, which limits the pressure of predation [216].

According to the generalised assessment of the impact of the suspended solids increased concentration on fish during the OWF construction that was conducted by Bergström *et al.* [29], a moderate (the Baltic Proper Baltic and the Danish straits) or low (the Gulf of Bothnia) potential level of this impact on fish should be expected. In the analysis conducted using the Ecological Risk Assessment method [431], the significance of suspended solids impact on different developmental stages of cod were assessed in the area of the project implemented on the spawning grounds of this species in the Danish straits [160]. The analysis indicated that only for the early developmental stages (eggs, larvae and fry up to 3 months old), there is a risk of the impact of this factor. However, no risk related to this factor was found for fish at other developmental stages.

Because of the prevailing hydrological conditions, the OWF Area is not a spawning ground of cod or 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 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 BC-Wind 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.

Cod, European flounder, common seasnail and sand goby sensitivity to impact was assessed to be moderate and for sprat and herring – to be high. The significance of the impact is assessed to be negligible for all the fish species analysed.

Emission of toxic chemicals

During construction, harmful chemical substances may be released. The main sources of emission may be the leaks of oil derivative substances caused by failures or sinking of vessels as well as the release of harmful substances from the sediments during dredging works (excavations for foundations of wind turbines, trenches for transmission infrastructure cables).

The sensitivity of fish to harmful substances depends on their developmental stage, sex and species. Maturing females, embryos and early larval stages are particularly sensitive. High concentrations of some harmful substances in the gonads of spawning fish may cause high mortality of their offspring [152, 500, 101].

The exposure of fish to toxic substances may cause morphological changes, such as abnormal development of reproductive organs, deformities of the lower jaw, eyes, spinal anomalies and a reduced larval size at hatching. Such effects were observed during surveys at the North Sea in such species as the common dab, flounder, cod [101] as well as herring (*Clupea harengus membras*) [256].

Physiological changes such as a reduced heart rate and endocrine disruptions, including those that reduce spawning efficiency, may also take place. Some authors [376, 427, 492] provide also the information on the occurrence of behavioural disorders resulting in the reduced effectiveness of fish feeding.

As has been already mentioned, the main toxic substances released into water during vessel collision or failure shall be oil derivatives. They include the especially hazardous polyunsaturated aromatic hydrocarbons (PAHs), which have been found to have negative effects on fish embryonic stages even at low concentrations [78]. 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 studies of Koehler [220] and Vethaak and Wester [482] 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.

According to the Helsinki Commission [HELCOM Guidelines for the Disposal of Dredged Material at Sea – adopted in June 2007], a series of substances may permeate from the sediment into the water, such as heavy metals (cadmium, chromium, copper, lead, mercury, nickel, zinc, arsenic), chlorinated biphenyls, organochlorine and organophosphorus pesticides, tributyltin (TBT) and its breakdown products, total hydrocarbons, polychlorinated dibenzodioxins, polychlorinated dibenzofurans and PCBs. However, it could be assumed that the risk of high concentrations of these substances caused by their release from the sediment in the area of the PMA is low. The analyses of the content of polychlorinated biphenyl, organochlorine and organophosphorus pesticides, and heavy metals (copper, zinc, cadmium, lead, mercury) in the sediments from different locations in the PMA, did not indicate the presence of the above substances in the concentrations which could cause negative effects in organisms [84]. The results of the measurements of the heavy metal concentrations (copper, zinc, cadmium, lead, and mercury) in the sediments and tissues of flounders in 2011 indicate a low level of accumulation of harmful substances in fish tissues [345]. Also, the DDT, HCB, PCDD/F concentrations in the sandy sediments of this area remain at a level not causing a toxic effect in the marine organisms [437].

The impact related to releasing pollutants and nutrients from the sediments into water will be negative, direct, temporary and local.

Cod, European flounder, common seasnail, sand goby, sprat and herring sensitivity to impact was assessed to be moderate.

The significance of the impact is assessed to be negligible for all the fish species analysed.

Habitat change

During construction, situations may take place in which, due to the impact of a series of harmful factors (noise, increased suspended solids concentration, intensive vessel traffic), the construction area will be avoided by fish. The scale of this impact depends both on the biology of individual species and their developmental stage [507]. The size of the area, duration and dates of the work are also crucial factors. In the case when even a small area is an important spawning ground, the effect of its exclusion from the reproduction processes may be visible at a much larger sea area [28].

Construction works may lead to physical changes in the environment, such as the sediment character or the seabed morphology. As a result of such changes, the disruption of the fish reproductive processes may take place [185, 186, 338, 353, 37]. The disruption of the original sediment structure may result in periodical abandonment of spawning or result in unfavourable development conditions for eggs or fry [152, 338]. Such a reaction may, for example, concern herrings requiring a seabed covered with sediment allowing the attachment of eggs [214, 353].

Also, the seabed surface is being occupied by the structural elements (wind turbine foundations, scour protection structures). The scale of this loss depends on the number of wind turbines and the type of foundations. However, it should not exceed 1% of the total project surface area. The loss of the surface available for the benthic organisms and the changes in environmental parameters may result in the reduction of the benthic abundance and biomass. In connection to the physical destruction of fauna inhabiting the sediment during construction, this may lead to the reduction of food supply for benthivorous fish [83, 77, 409] and cause the reduction of their number. Taking into consideration the probable small spatial scale of this impact and the ability of fish to actively forage for food, it can be assumed that the reduction in food resources will not be significant for benthivorous fish.

The BC-Wind OWF Area is neither a spawning ground of cod nor of 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 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.

Cod, European flounder, common seasnail, sand goby, sprat and herring sensitivity to the impact was assessed to be high. The significance of the impact is assessed to be negligible for all the fish species analysed.

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 the migration processes [424]. 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 all species.

Cod, European flounder, common seasnail, sand goby, sprat and herring sensitivity to impact was assessed to be moderate. The significance of the impact is assessed to be negligible for all the fish species analysed.

6.1.1.4.1.4 Marine mammals

During the construction phase of the BC-Wind, marine mammals may be subject to impacts resulting from:

- underwater noise generated by piling;
- noise generated by vessel traffic;
- increase in the suspended solid content in the water;
- habitat changes;
- leakage of oil derivatives into the environment due to vessel breakdowns.

Noise generated by piling

Essentially, the impact of noise on marine mammals may be divided into the following five broad categories, which depend to a large extent on the distance of an animal from the source of sound [163, 352, 360]:

- detection;
- masking;

- changes in behaviour (behavioural response);
- physical injury of hair cells as a result of exposure to noise (TTS, PTS);
- physical and physiological effects.

It should be noted that the boundaries of the noise impact zones specified above are not clear-cut and that individual zones overlap to a large degree. Generally, it is assumed that the detection zone of the OWF sound is quite large for the marine mammals due to the high level of the noise generated [448]. However, the detection zone is not usually included in the assessment of effects. The physical and physiological effects include injuries to tissues and physiological consequences (e.g. stress). In extreme cases, tissue damage may lead to the animal's death. However, when it comes to pile driving, not much is known about the exact nature of some of the impacts (e.g. stress) and about the spatial range of this zone for the marine mammals and fish. Therefore, in the majority of cases this is not directly surveyed in the Environmental Impact Assessments of the OWF.

Masking occurs when the noise disrupts the detection of biologically significant signals used by the marine animals to communicate and navigate. It is a phenomenon naturally occurring in the environment that takes place when the frequencies of the signal of interest and the noise overlap. The ranges of masking by anthropogenic noise depend on their levels, as well as the existing levels of the ambient noise and many other factors [117]. One of them is the temporal structure of noise [55]. For the pulsed sounds, such as those generated by piling, masking is essentially irrelevant, so it is not taken into consideration here [261, 448].

Changes in the behaviour of porpoises as a result of the anthropogenic noise are mostly reversible and short-term. The most common reaction of those animals to pile driving is moving away from the piling area, sometimes moving to less favourable areas, disruption of feeding and changes in mating behaviours [411, 458]. The response of a harbour porpoise in captivity (kept in a small reservoir) to the sound of pile driving were an acceleration of the respiratory rate, and more frequent jumps out of water at higher noise levels [209]. During the construction of the Alpha Ventus OWF in the German part of the North Sea, the avoidance reaction to the piling area (exceeding 21 km from the source of noise) was observed in harbour porpoises [88, 455]. In other surveys in the North Sea, it has been shown that the harbour porpoise travels at distances of up to 26 km in response to piling [54]. During the construction of the Horns Rev II OWF, the activity of these marine mammals was limited during and after piling at a distance of up to 17.8 km. At the nearest distance surveyed (up to 2.5 km), the activity of harbour porpoises decreased in a 24–70-hours break after the pile driving. A similar reaction was observed during the construction of the Alpha Ventus OWF, when the break in the porpoise activity lasted up to 20–35 hours after the pile driving [52]. Additionally, Graham *et al.* [149] have shown that the response of the harbour porpoise to the noise generated by pile driving diminishes with time. They studied the behavioural response of harbour porpoises to the noise generated by pile driving during the 10-month erection of foundations for the OWF in the North Sea. At that time, they recorded a probability of the harbour porpoise behavioural response at a level of 50% within a radius of up to 7.4 km when the first piling took place, and at the last piling the behavioural response range decreased to 1.3 km.

Generally speaking, the studies of the behavioural effects of pile driving on the changes in the harbour porpoise behaviour have shown a relatively low reaction thresholds, at a level of approx. 140 dB re 1 $\mu\text{Pa}^2\text{s}$ on average [53, 88] [Table 6.10]. On the basis of the results of these surveys in the EIA Report

for the BC-Wind OWF, the behavioural threshold of 140 dB re 1 $\mu\text{Pa}^2\text{s}$ SEL was used for estimating the harbour porpoise avoidance zone.

Table 6.10. Field surveys investigating the response of harbour porpoises to pile driving [Source: internal materials based on [411]]

Source	Sound level	Location	Comments
Tougaard <i>et al.</i> [455]	130 dB re 1 μPa rms	Pile driving in the Horn Reef I OWF Area	No threshold was specified
Brandt <i>et al.</i> [53]	149 dB re 1 μPa rms	Pile driving in the Horn Reef II OWF Area	Results probably overestimated due to disregard for the reef soundproofing effect
Tougaard <i>et al.</i> [459]	130 dB re 1 μPa rms	Experiments conducted in Fyns Hoved, the Great Belt, Denmark	Piling was not real – sounds of pile driving were played back from underwater loudspeakers
Dähne <i>et al.</i> [88]	140 dB re 1 $\mu\text{Pa}^2\text{s}$ SEL	Pile driving in the Alpha Ventus OWF Area	Additionally, aerial observations were introduced
Kastelein <i>et al.</i> [209]	>136 dB re 1 μPa rms	Play back experiments were conducted	Harbour porpoises in captivity

The long-term surveys on the presence of harbour porpoises in an OWF area after the completion of construction works are sparse. In 2011, Scheidat *et al.* [403] noted an increase in the number of harbour porpoises in the area of the Danish OWF after the completion of its construction. However, a general increase in the occurrence of harbour porpoises in the southern part of the North Sea was observed at that time, which can constitute an explanation for the above-mentioned observations rather than a positive impact of the OWF [446]. Whereas, in 2012, Teilmann *et al.* [441] found a negative long-term tendency in the occurrence of harbour porpoises in the area of the Danish OWF. However, this survey area seemed to have a low density of these animals from the beginning, so the changes in occurrence could have only resulted from the small differences in sample sizes. The recently published study covering 11 OWF Areas in the German Bight have shown that in the survey area, acoustic detections of the harbour porpoise increased, pointing to the lack of unfavourable long-term effects of the OWF on these animals [375].

Analogically to the harbour porpoise, in the case of seals, the changes in behaviour as a result of pile driving are rather reversible and short-term. However, the literature data available are limited. Neither harbour seals nor grey seals reacted to noise generated by pile driving in the Danish waters in their resting places [101]; however, Russell *et al.* [393], when studying the impact of the OWF construction on the harbour seal in the south-eastern England, have observed that their abundance significantly decreased in the construction area up to 25 km from the piling site during pile driving [19–83% (95% confidence interval (CI))]. It is estimated that 440 individuals emigrated. Significant movement of animals began with SEL between 142 and 151 dB for 1 $\mu\text{Pa}^2\text{s}$. Movement of seals was limited to 2 hours after the pile driving was stopped. Kastelein *et al.* [208] who have investigated the response of harbour seals living in captivity to the sound of pile driving, and noticed that these animals spent more time on the surface of the water during the exposure to sound. During the construction of two OWFs in the Dutch waters, Luchterduinen and Gemini, the behavioural reactions of the grey seal were studied [1]. The animals reacted in different ways: by changing their behaviour on the water surface or during a dive, changing the direction of movement, including swimming away from the source of the noise, escaping to the shore or swimming perpendicular to the sound perceived. Sometimes, no changes in

the behaviour of seals were observed. However, their most common behavioural response was a decrease in the swimming speed, which suggests a change of behaviour from feeding (diving towards the seabed) to more horizontal movement. Such changes occurred much more often at smaller distances from the pile driving source and were statistically relevant up to at least 36 km [1].

In the EIA Report for the BC-Wind OWF, the noise exposure criteria for seals were introduced on the basis of the sound level received (in SEL), where the 50% change in area usage (median) occurred for the water depth with the highest levels of the sound received [393]. As a result, the criterion of 158 dB per 1 $\mu\text{Pa}^2\text{s}$ for the behavioural response of seals was established.

The noise-induced threshold shifts may lead to temporary changes (TTS) or permanent changes (PTS). With TTS, the animal shall regain its original hearing after a recuperation period. On the other hand, PTS leads to irreversible changes in the hearing organ. Unlike TTS, PTS in the harbour porpoise has not been measured. In several studies, TTS in the harbour porpoise exposed to intensive pulsed noise has been documented. Lucke *et al.* [257] have measured TTS in a harbour porpoise exposed to a single sound pulse from projectiles used for seismic surveys, and the TTS exceeded 6 dB after an exposure to 164.3 dB re 1 $\mu\text{Pa}^2\text{s}$. Kastelein *et al.* [204] have also induced TTS in a harbour porpoise, however, using a longer duration of noise with a lower octave band level around 4 kHz. An exposure at a level of 124 dB re 1 μPa for 120 minutes induced 6 dB TTS. Kastelein *et al.* [207] have induced TTS in two harbour porpoises after exposing them to pile driving sounds played back at 4 and 8 kHz. The sounds of pile driving at 8 kHz resulted in a higher TTS than at 4 kHz. The animals were exposed to a single strike of an unweighted broadband level of noise of 145 dB re 1 $\mu\text{Pa}^2\text{s}$ for 15–360 minutes (cumulative range of SEL 173–187 dB re 1 $\mu\text{Pa}^2\text{s}$). The average TTS (1–4 minutes after the exposure to sound in the first harbour porpoise and 12–16 minutes in the second animal) increased from 0 dB after 15 minutes of exposition to the noise to 5 dB after 360 minutes. The animals regained their primary hearing within 60 minutes after the exposure to noise ceased. Popov *et al.* [347] have studied TTS in the finless porpoise from the Yangtze River (*Neophocaena phocaenoides asiaeorientalis*). After exposing it to continuous noise from a half-octave band centred at 32, 45, 64 or 128 kHz for 30 minutes, TTS in that porpoise was induced at a level of 140 dB re 1 μPa . TTS may occur near the main frequency of continuous sounds [206], as well as pulsed sounds of low frequency [257], but may also occur at higher frequencies. It seems that the lower the central frequency of the noise, the greater the noise exposure effect [347].

TTS in seals has also been studied. Kastelein *et al.* [208] have estimated that the beginning of TTS occurred at approx. 192 dB for 1 $\mu\text{Pa}^2\text{s}$ SEL (cumulative) in two harbour seals, exposed to a broadband piling noise played back. On the other hand, Reichmuth *et al.* [361] have not induced TTS in the ringed seal exposed to the noise from projectiles, even at levels previously reported as beginning levels for TTS. It was suggested then that seals may learn to tolerate loud pulsed sounds. TTS in harbour seals exposed to noise of longer duration has been studied twice [203, 204]. Kastak *et al.* [203] have been able to induce 6 dB TTS after 25 minutes of exposure, using an octave noise of a 2.5 kHz central frequency. Kastelein *et al.* [204] have concluded that TTS of approx. 6 dB was induced after 60 minutes of exposure to 136 dB re 1 μPa in relation to an octave band noise of a 4 kHz central frequency. Sills *et al.* [408] have studied the impact of single and repeated impulses, generated as a result of seismic surveys using projectiles, on the bearded seal. They have found no evidence for TTS after a single strike at SEL 185 dB re 1 $\mu\text{Pa}^2\text{s}$ and 207 dB re 1 μPa of the peak level of sound pressure. However, with the increase in the number of exposures to noise from 4 to 9, TTS have been recorded at 400 Hz

(cumulative SEL 191–195 dB re 1 $\mu\text{Pa}^2\text{s}$, SEL with frequency weighted for seals in water 167–171 dB re 1 $\mu\text{Pa}^2\text{s}$).

PTS in the harbour seal was accidentally induced after two consecutive 60-second exposures to 4.1 kHz of a clear tone. In the beginning, this caused a threshold shift for 5.8 kHz above 50 dB, and more than two months after, the threshold shift was 7–10 dB [202].

The above results show that there is a significant variation in noise levels causing TTS or PTS in marine mammals. As a result, the hearing loss thresholds, TTS and PTS, have been widely discussed. In 2007, the first set of criteria of noise impact on marine mammals was proposed, on the basis of the data from literature available at that time [421]. From that moment, these criteria have been verified and corrected multiple times [127]. In 2018, NMFS [301] published updated general recommendations concerning the occurrence of PTS and TTS for different marine mammals hearing classes, in accordance with Southall *et al.* [421] for continuous and pulsed noise. These thresholds have been additionally confirmed in the recently reviewed publication by Southall *et al.* [422], although with minor changes in the nomenclature for various groups of animal hearing.

Generally, mammals do not hear equally well across their entire auditory range. With reference to the lower and upper limit of cut-off frequency, the volume perceived becomes lower than the one predicted on the audiogram [296]. To compensate for this discrepancy in the volume perceived, the frequency weighting function was proposed for individual animal groups. Southall *et al.* [421] have developed the first filters with identical volume for various marine mammal groups (M-weighting). They have been used by NMFS [301] and Southall *et al.* [422] to develop the criteria of noise impact on the frequencies weighted. These criteria should be perceived as the most comprehensive and therefore they have been used in the BC-Wind OWF assessment.

The summary of noise exposure criteria values is presented in Table 6.11.

Table 6.11. Overview of noise exposure criteria used to calculate the impact ranges for marine mammals (PTS = permanent threshold shift, TTS = temporary threshold shift, SEL = sound exposure level, many impulses = a series of consecutive impulses, SPL_{peak} = peak level of sound pressure) [Source: internal materials]

Source	Effect	Species	Type of sound modelled	Threshold value SEL weighted	Threshold value SPL_{peak}
NMFS 2018 [301]	PTS	Harbour porpoise	Single strike and 1-hour cumulative	155 dB re 1 $\mu\text{Pa}^2\text{s}$	202 dB re 1 μPa
	TTS	Harbour porpoise	Single strike and 1-hour cumulative	140 dB re 1 $\mu\text{Pa}^2\text{s}$	196 dB re 1 μPa
	PTS	Grey seal and harbour seal	Single strike and 1-hour cumulative	185 dB re 1 $\mu\text{Pa}^2\text{s}$	218 dB re 1 μPa
	TTS	Grey seal and harbour seal	Single strike and 1-hour cumulative	170 dB re 1 $\mu\text{Pa}^2\text{s}$	212 dB re 1 μPa
Skiellerup <i>et al.</i> [411]	Changes in behaviour (behavioural)	Harbour porpoise	Single strike	140 dB re 1 $\mu\text{Pa}^2\text{s}$ (unweighted SEL)	-
Russell <i>et al.</i> [393]	Changes in behaviour (behavioural)	Harbour seal	Single strike	158 dB re 1 $\mu\text{Pa}^2\text{s}$ (unweighted SEL)	-

Rare occurrence of the **grey seal** in the survey area [Subsection 3.7.4.4] [169] and a relatively small impact ranges calculated [Appendix 1 to the EIA Report, subsection 5.1.2 and Appendix 3] indicate that the significant impact of noise on the grey seal is low or moderate for all the criteria, with the exception of TTS for a cumulative dose of noise from 1-hour of pile driving. In this case, the animals can be affected by the impact of noise at a distance of up to 140 km from the location of piling. For this criterion, without the application of mitigation measures, the impact on the population may be significant [Appendix 3 to the EIA Report]. However, after the application of a mitigation measure in the form of an NRS, the sound levels and the impact ranges decrease significantly. This results in the change of the impact significance from low to moderate for all responses, including the TTS for cumulative strikes [Table 6.13].

The total number of **grey seals** in the Baltic Sea is small, with an estimated population abundance of 1563 individuals in the south-western part of the Baltic Sea (NOVANA, Jonas Teilman, personal communication) and approx. 1200 individuals counted as the Kalmarsund population [169]. The majority of harbour seals in the south-western part of the Baltic Sea gather in Falsterbo, Saltholm and Bøgestrømmen, far to the west of the BC-Wind OWF Area. Seals of the Kalmarsund population can be observed closer to the BC-Wind OWF Areas, however, usually, they do not travel further than 50–100 km from their permanent locations (haul-outs) [312]. Taking into consideration the rare occurrence of the harbour seal in this area [subsection 3.7.1.4] and a relatively low scale of impact calculated [Appendix 1 to the EIA Report, subsection 5.1.22 and Appendix 3], the significance of the impact of noise from piling for the harbour seal is low to moderate for all responses, with the exception of the TTS for a cumulative dose of noise from 1-hour of pile driving. Nevertheless, after the application of an NRS, the significance of the impact of noise from piling for the harbour seal shall be low to moderate for all responses [Table 6.13].

To estimate the percentage of **harbour porpoises** affected by the impacts from the construction of the BC-Wind OWF, modelled areas were used [Appendix 1 to the EIA Report, subsection 5.1.2]. The sizes were determined on the basis of the maximum impact ranges. Next, the number of animals affected was estimated on the basis of the harbour porpoise density estimations from the SAMBAH project [398]. Due to a very large variation in estimates, both the lower as well as the upper CI limit provided by SAMBAH (0.00060–0.00823 ind./km²) were applied [398]. The percentage of harbour porpoises affected by the impact within the population was calculated by dividing the number of animals in the impact area (the lower and upper CI limit) by the general size of the population (corresponding to the lower and upper CI limit) (95% CI 80–1091) [398]. The results are presented in Table 6.12. Taking into consideration the calculated percentage of the animals affected by the effects and scale of the impact, the significance of the impact varies for the harbour porpoise for each of the responses. It can be noted that these animals are hardly affected by the TTS and PTS from single pile driver strikes. After a 1-hour exposition to the noise from pile driving (SEL_{cum}), the percentage of populations affected by the TTS and PTS is greater for the population affected by the TTS and PTS at single pile driver strikes. Up to 3.54% of the harbour porpoise population may be affected by the PTS for cumulative SEL, which may cause a significant impact on the population. In the case of the TTS at SEL_{cum}, the percentage increases up to 17.27% of the population, which constitutes a significant impact. However, after the application of an NRS, the percentage of animals affected by TTS and PTS decreased to 0.18–1.14% [Table 6.12], which would, in the worst-case scenario, cause the change of the impact to moderate [Table 6.13].

Table 6.12. Proportion of harbour porpoises affected by the impact in the BC-Wind OWF Area with and without the application of a noise reduction system (NRS). 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 [398] [Source: internal materials]

Effect	Impact area [km ²]		Estimated number of individuals in the Baltic population [NE]	Estimated density in the modelling area [ind. km ⁻²]	Without NRS		With NRS	
	Without NRS	With NRS			Number of harbour porpoises affected by the impact in the area modelled	Percentage of harbour porpoises in the population affected by the impact [%]	Number of harbour porpoises affected by the impact in the area modelled	Percentage of harbour porpoises in the population affected by the impact [%]
PTS (single strike)	5.6	0.03	80–1091	0.00060–0.00823	0	0	0	0
PTS (1h cum.)	4700	250	80–1091	0.00060–0.00823	3/39	3.52/3.54	0/2	0.18/0.19
TTS (single strike)	220	6.6	80–1091	0.00060–0.00823	0/2	0.16/0.17	0	0
TTS (1h cum.)	22900	1500	80–1091	0.00060–0.00823	14/188	17.18/17.27	1/12	1.13/1.14
Behavioural response	18500	870	80–1091	0.00060–0.00823	11/152	13.88/13.96	0/7	0.65/0.66

Noise generated by vessel traffic

The types of vessels used during the construction of OWFs can be divided into: wind turbine installation vessels (WTIV), cargo barges, lift barges, jack-up platforms and tugs [5]. The measurements of the noise emitted by a cargo ship with a length of 173 m and powered by a low-speed direct-drive diesel engine have been conducted by Arverson and Vendittis [17]. The sound level recorded was 174 dB re 1 μ Pa at 9 Hz. The sound levels of drill ships were measured experimentally at 142–145 dB re 1 μ Pa rms with a frequency of 30–2000 Hz (approximate levels for the jack-up type platforms) [116]. A tugboat towing an empty barge emitted noise with a value of 145 dB re 1 μ Pa at a frequency of 5 kHz, while a tugboat with a cargo – 170 dB re 1 μ Pa at a frequency of 1 kHz [360]. Small fast vessels, such as barges and supply vessels generate noise mainly of the frequencies from <1 kHz to >10 kHz [107, 173]. Probably, the increased activity of vessels during the OWF construction phase shall lead to the increase of the acoustic field, covering frequencies that partially concern marine mammals [173]. Harbour porpoises, grey seals and harbour seals are more sensitive to higher frequencies. The studies have shown that harbour porpoises respond to lower levels of high component frequencies of the noise generated by vessels [107, 511]. In their studies, Wiśniewska *et al.* [511] have studied the free-living harbour porpoises in the Danish waters, using acoustic tags (DATG) attached to animals. They have discovered that the exposure to a sudden noise of high frequencies, which could have been caused by a fast-moving vessel, for the harbour porpoise resulted in energetic flapping of the fluke, disturbed feeding and even sporadic suppression of echolocation. These behavioural changes were recorded at a distance of several kilometres from the vessel. Increased noise from vessels connected to the construction phase may, thus, constitute a potential problem for animals, and the presence of vessels in the OWF development area may result in the displacement of harbour porpoises or the incurring of energy costs due to the reduction of feeding and the necessity to move away from the vessels. The intensification of disturbing factors depends on the type and number of vessels that emit medium- and high-frequency sounds. Probably, such vessels constitute a minority of the vessels used for the OWF construction. In their studies, Wiśniewska *et al.* [511] have shown that the free-living harbour porpoises are exposed to the noise from vessels from 17–89% of the time. Some of the areas with the highest vessel traffic in the Danish waters (e.g. the Great Belt and the Little Belt) are also the areas with a very high abundance of harbour porpoises [432], where they are very often exposed to the noise generated by vessels, however, the level of this noise is low [511]. Therefore, all displacements of the harbour porpoise caused by the noise from vessels during the BC-Wind OWF construction shall be probably short-term and at relatively close distances (<10 km).

It is assumed that the same behaviours shall apply to the two species of seals discussed in the report, because seals are also very often encountered in the areas with high marine traffic [198]. In a recently published study [291], using acoustic tags (DATG), which are able to record both the sounds and the animal behaviour at the same time, Mikkelsen *et al.* have shown that harbour seals and grey seals were exposed to the noise from vessels 2.2–20.5% of their time spent in the sea. Moreover, seals changed their behaviour during diving in a response to the vessel noise [291].

It is expected that the level of ambient noise shall not increase significantly as a result of an increased navigation caused by the construction of the BC-Wind OWF. Besides, it will be a short-term impact. Therefore, the noise generated by the traffic of vessels has been assessed to have a minor impact despite its direct nature.

Increase in the content of suspended solid in the water

It is expected that the increase in the content of suspended solid in the water related to the construction of the BC-Wind OWF shall be short-term, and therefore, of low significance for the harbour porpoise, grey seal and harbour seal.

Changes in the habitat

Changes in the habitat of marine mammals related to the construction of the BC-Wind OWF include the changes of the seabed and the increase in the number of vessels on the surface, which indirectly affect marine mammals. However, none of these changes shall have a significant impact compared to the effect of the noise generated during the construction phase. Thus, the significance of this factor for harbour porpoises and seals was assessed to be low.

Leakage of oil derivatives into the environment due to vessel breakdown

Vessel collisions and breakdowns resulting in a leakage of oil in the BC-Wind OWF project implementation area may negatively affect marine mammals, even those present in the neighbouring waters. Such a scenario is highly unlikely, but if it occurs it will have a very large impact on marine mammals. Taking this into consideration, the significance of this factor for harbour porpoises and seals was assessed to be moderate. Development of an oil pollution prevention plan and an action plan in the case of such situations at various stages of the project implementation is recommended.

Assessment of the impact significance in the construction phase

The methodology developed for the purpose of the EIA Report was adopted for the impact assessment. The significance of the BC-Wind OWF impact was assessed for the construction phase after the application of an NRS. The results are presented in Table 6.13. The basis for the assessment were the results of numerical modelling, included in Appendix 1 to the EIA Report. After the NRS was applied, all impacts on the harbour porpoise, grey seal and harbour seal were assessed to be low or moderate.

Table 6.13. Significance of the impact on marine mammals resulting from piling during the construction phase after the application of a noise reduction system (NRS) [Source: internal materials]

Species	Impact	Impact description	Impact significance
Harbour porpoise <i>Phocoena phocoena</i>	PTS (single strike)	Permanent threshold shift as a result of a single pile driver strike	Low
	PTS (1h cum.)	Permanent threshold shift as a result of a cumulative noise dose from one-hour piling	Moderate
	TTS (single strike)	Temporary threshold shift as a result of a single pile driver strike	Low
	TTS (1h cum.)	Temporary threshold shift as a result of a cumulative noise dose from one-hour piling	Moderate
	Behavioural response	Behavioural responses to pile drilling (moving away from the construction site)	Moderate
	Noise related to navigation	Behavioural responses to the noise related to navigation (moving away from the location of construction operations)	Low
	Suspended solids	Behavioural changes caused by the suspension of sediments released during construction	Low
	Changes in the habitat	Behavioural changes caused by the habitat changes resulting from the construction operations	Low
	Vessel collisions and breakdown	Pollution caused by the collision of vessels used for the construction purposes (e.g. fuel leak)	Moderate

Species	Impact	Impact description	Impact significance
Grey seal <i>Halichoerus grypus</i>	PTS (single strike)	Permanent threshold shift as a result of a single pile driver strike	Low
	PTS (1h cum.)	Permanent threshold shift as a result of a cumulative noise dose from one-hour piling	Moderate
	TTS (single strike)	Temporary threshold shift as a result of a single pile driver strike	Low
	TTS (1h cum.)	Temporary threshold shift as a result of a cumulative noise dose from one-hour piling	Moderate
	Behavioural response	Behavioural responses to pile drilling (moving away from the construction site)	Moderate
	Noise related to navigation	Behavioural responses to the noise related to navigation (moving away from the location of construction operations)	Low
	Suspended solids	Behavioural changes caused by the suspension of sediments released during construction	Low
	Changes in the habitat	Behavioural changes caused by the habitat changes resulting from the construction operations	Low
	Vessel collisions and breakdown	Pollution caused by the collision of vessels used for the construction purposes (e.g. fuel leak)	Moderate
Harbour seal <i>Phoca vitulina</i>	PTS (single strike)	Permanent threshold shift as a result of a single pile driver strike	Low
	PTS (1h cum.)	Permanent threshold shift as a result of a cumulative noise dose from one-hour piling	Moderate
	TTS (single strike)	Temporary threshold shift as a result of a single pile driver strike	Low
	TTS (1h cum.)	Temporary threshold shift as a result of a cumulative noise dose from one-hour piling	Low
	Behavioural response	Behavioural responses to pile drilling (moving away from the construction site)	Low
	Noise related to navigation	Behavioural responses to the noise related to navigation (moving away from the location of construction operations)	Low
	Suspended solids	Behavioural changes caused by the suspension of sediments released during construction	Low
	Changes in the habitat	Behavioural changes caused by the habitat changes resulting from the construction operations	Low
	Vessel collisions and breakdown	Pollution caused by the collision of vessels used for the construction purposes (e.g. fuel leak)	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 accounted primarily for the presence of construction vessels during the conduct of work. Impacts on migratory birds resulting from the barrier effect and collision with the BC-Wind OWF structures were assessed for the operation phase, when their effects are the greatest. The detailed assessment of the impact of the BC-Wind OWF during the construction phase on migratory birds is included in Appendix 4 to the EIA Report.

The significance of the impact of the BC-Wind 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 [Table 6.14].

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Table 6.14. Significance of impacts related to the construction phase of the OWF on birds migrating through the BC-Wind OWF Area; equal impacts for both variants of the wind farm have been adopted [Source: internal materials]

Species	Impact	Impact scale	Duration	Intensity	Impact frequency	Impact reversibility	Size of impact	Impact significance
All migratory bird species listed in Table 3.12 of moderate and high significance	Ship barrier	Local	Temporary	Low	Repeated	Reversible	Irrelevant	Low
	Collisions with vessels	Local	Temporary	Low	Repeated	Reversible	Irrelevant	Low
All migratory bird species listed in Table 3.12 of low significance	Ship barrier	Local	Temporary	Low	Repeated	Reversible	Irrelevant	Negligible
	Collisions with vessels	Local	Temporary	Low	Repeated	Reversible	Irrelevant	Negligible

6.1.1.4.1.6 Seabirds

Identification of the main factors affecting seabirds during the construction phase

The impact of the planned project in the construction phase shall mainly have a local character, i.e. shall be limited to the construction area – BC-Wind OWF shall be located outside the protected areas, including the Natura 2000 sites.

To identify the significance of the impact, its scale was assessed to be high for the long-tailed duck, the velvet scoter and the common scoter, moderate for the razorbill and the common guillemot and irrelevant for the European herring gull.

The factors identified and the assessment of their impact on the marine avifauna in the construction phase is presented below.

Vessel traffic

Construction works shall require the presence of various types of vessels, which shall disturb the seabirds with their physical presence, the noise (including the noise generated by pile driving, if such foundations are selected) and the emission of light. The two first factors should not impact the change of the flight route of those waterbird species that do not use this area but only fly over it (e.g. the common scoter). However, it cannot be ruled out that such an impact will occur at night, especially if the construction site is strongly illuminated. This is because during migration birds navigate in relation to natural light sources such as stars and the sun. It has been observed that at night they also fly towards lighthouses, drilling rigs and other structures illuminated with artificial light [501]. The impact scale shall depend on the number of vessels involved, their sizes, their illumination type and the intensity of light sources. It also depends on the duration of the construction phase and the location of the wind turbines within the OWF Area, in which the increased vessel traffic shall take place. The period in which the work occurs is important, as most seabird species, including the long-tailed duck, show very large differences in abundance between phenological periods. The effect of scaring will increase with the progressing development of the OWF Area. Initially, it shall be of local nature and the birds shall be able to find feeding grounds in the vicinity (e.g. in the neighbouring Natura 2000 site Przybrzeżne wody Bałtyku), however, in the final phase of the construction, the range of this impact shall visibly increase, strongly limiting the birds ability to feed and rest in the OWF Area.

The presence of vessels and fixed structures protruding from the water, on the other hand, will lead to a greater presence of gulls, which use these elements as resting places and search for food near the vessels. Three species of large gulls, including the most abundant there the European herring gull, gather in the open sea around the fishing boats. If during the construction (or later operation) of the OWF, the commercial fishing becomes restricted in this sea area, the gulls shall move (at least partially) to other fishing locations.

The traffic of vessels in the construction phase shall result in direct, negative, and local impact on seabirds. For the razorbill, the common guillemot, the European herring gull, the velvet scoter and the common scoter this is a medium-term impact, and for the long-tailed duck it is short-term and temporary.

The sensitivity to impact was assessed to be low for the European herring gull and high for the other species.

The significance of the impact varies for individual species and it is assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot as well as important for the duck species analysed – the long-tailed duck, the velvet scoter and the common scoter.

Emission of noise and vibrations

The presence and movement of construction vessels shall constitute the main reason for seabird disturbance in the sea area covered by the BC-Wind OWF construction. This impact shall be much greater than other pressures connected to the construction phase, such as underwater noise emission.

However, it is worth noting that the monitoring of birds during the construction of the Egmond aan Zee OWF in Holland did not indicate any noticeable reaction of the bird species not sensitive to the disturbances related to the presence of vessels (mainly gulls and terns) to piling [252].

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 some of the seabird species (diving piscivorous birds). The use of an NRS and the application of a mitigating measure (soft-start procedure at piling) shall minimise the negative impact.

Noise and vibrations during the construction phase are direct, negative impacts on seabirds of local range, medium-term, reversible, repeatable during the construction period, and of species-dependent intensity.

The sensitivity to impact was assessed to be low for the European herring gull and high for the other bird species.

The significance of the impact varies for individual species and it is assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot as well as important for the duck species analysed – the long-tailed duck, the velvet scoter and the common scoter.

Lighting of the project site

During migration, birds navigate in relation to natural light sources such as stars and the sun. It has been observed that at night they also fly towards lighthouses, drilling rigs and other structures illuminated with artificial light [501]. During surveys on bird behaviour near drilling rigs, it has been observed that illumination causes seabirds to gather around such structures not only during the migration period. It mostly applied to the Procellariiformes, which are usually most active at night, but was also observed in the case of the little auk (*Alle alle*) [501], which are closely related to razorbills and common guillemots, found in the area of the planned project. However, in the case of the majority of typical seabirds (sea ducks, divers), the impact of artificial lighting on birds residing in the near and distant vicinity of light sources remains very poorly studied.

The illumination of the project location during the construction phase shall cause direct and negative impact on seabirds of local range, medium-term, reversible, repeatable during the construction period, and of species-dependent intensity.

The sensitivity to the impact was assessed to be low for the European herring gull and high for the other species.

The impact significance varies for individual species and it is assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot as well as important for the duck species analysed – the long-tailed duck, the velvet scoter and the common scoter.

Barrier creation

The structures of the power station, gradually appearing during the construction phase, will deter birds. This impact shall depend on the rate of the OWF construction. At the beginning, individual wind turbines shall have a small impact, however, gradually the animal-scaring effect shall increase. The data from literature clearly indicate that seabirds avoid sea areas occupied by wind turbines and their abundance decreases within a 2 or even 4 km radius [61, 327, 253, 233]. Adult birds are likely to be able to get used to the presence of the OWF to some extent. However, individuals starting their migration towards the wintering grounds for the first time in their lives may have problems avoiding the extensive barrier of the aggregation of OWFs. This may result from a smaller experience, which is the cause of a higher bird mortality in the first year of life [74, 360, 275]. Lack of data on the bird diseases in the vicinity of spatially extensive OWFs indicates the necessity to plan surveys of a post-investment monitoring character. It must be emphasised that a parameter affecting the level of impact is the number of power stations under construction. The distance between particular wind turbines at a farm and the neighbouring OWFs is also important. Both, the construction and operation of the wind turbine located at a small distance from the BC-Wind OWF shall create a cumulative barrier effect for the birds.

Moreover, the presence of a large number of vessels used during the construction of the OWF may result in the creation of an additional barrier effect, thus, reducing the possibility for birds to travel between stopover areas during migration. The impact scale shall depend on the number of vessels involved in the construction phase, their size, construction phase duration time and the phenological period, in which the work is carried out.

The sensitivity to the impact was assessed to be low for the European herring gull and high for the other species under analysis.

The impact significance varies for individual species and it is assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot as well as important for the duck species analysed – the long-tailed duck, the velvet scoter and the common scoter.

Collisions with vessels

Collisions of birds with vessels used for the construction of the OWF may take place, mainly at night, when the birds shall be attracted by the light they emit. The impact scale shall depend on the number of vessels involved in the construction phase, their size, the configuration of light and their intensity, construction phase duration and the phenological period, in which the work is carried out.

The sensitivity to the impact was assessed to be low for the European herring gull and high for the other species.

The significance of the impact of collisions with vessels varies for individual species and it is assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot as well as important for the duck species analysed – the long-tailed duck, the velvet scoter and the common scoter.

Destruction of benthic habitats

The construction of foundations or support structures (especially, if GBS foundations are selected) and the laying of internal power cables shall cause numerous disturbances of the seabed communities in the project implementation areas.

Some of the habitats used by seabirds as stopover areas during migration shall be lost due to the erection of foundations or support structures. This process shall have a direct impact on the seabed and the water depth. The natural benthic environment shall be lost, however, most likely new ones shall be created in their place (artificial reef effect). The range of impact will mainly depend on the number of foundations or support structures of wind turbines 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, these species are very sensitive to being disturbed by the presence of vessels and other human activities at sea; therefore, the impact involving disturbances as a result of the presence of construction vessels shall be the main impact in this area, which shall lead to the displacement of the sensitive species to other areas. As a result, these birds shall additionally experience the impact related to the occupation of space during the construction phase.

The destruction of benthic habitats during the construction works poses an indirect, negative impact on some of the seabirds (mostly benthivorous birds), which is of local range, medium-term, reversible, repeatable in the construction period (for each of the wind turbines or infrastructure elements), with a species-dependent intensity.

The sensitivity to the impact was assessed to be irrelevant for the European herring gull, moderate for the razorbill and the common guillemot, and high for the long-tailed duck, the velvet scoter and the common scoter.

The significance of the impact varies for individual species and it is assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot as well as low for the duck species analysed – the long-tailed duck, the velvet scoter and the common scoter.

Increase in the content of suspended solids in the water and sedimentation of the sediment disturbed

These factors may affect the ability of diving benthivorous and piscivorous birds to find food.

During the OWF construction, the seabed sediments will be disturbed and the concentration of suspended solids in the water will increase. This phenomenon shall be the most intensive in the case of GBS, which require prior preparation of the seabed.

The direct transfer of sediments and their re-suspension shall result in the decrease in the water transparency. If it exceeded the naturally occurring levels, it could cause difficulties for birds using their eyes to hunt while foraging (divers, sea ducks, razorbills), and could result in the displacement of birds that prefer clearer waters. No impact is expected on the birds foraging on the water surface (gulls).

A local decrease in the water transparency in the OWF Area shall be short-term, and its impact shall be mitigated by other, more intense disturbances causing birds to leave the area.

The deposition of sediments related to the preparation of the OWF seabed for the erection of foundations or support structures of wind turbines may impact the benthic environment located in the OWF Area and in its vicinity. A layer of sediments raised shall deposit on the benthic organisms, which shall interfere with the gas exchange ability of these organisms and their uptake of nutrients. This phenomenon may lead to a reduction in benthic resources and the fish that feed on it (reduction of biomass, reduction of growth and productivity), and thus, affect the food supply of seabirds in the area.

The increase in the content of suspended solids during construction works and the deposition of the sediment disturbed constitutes an indirect, negative impact on some seabirds (birds diving in search of food), which is local, medium-term, reversible, repeatable in the construction period, and of low intensity.

The sensitivity to the impact was assessed to be irrelevant for the European herring gull, moderate for the razorbill and the common guillemot, and high for the long-tailed duck, the velvet scoter and the common scoter.

The significance of the impact varies for individual species and it is assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot as well as low for the duck species analysed – the long-tailed duck, the velvet scoter and the common scoter.

Table 6.15 presents the compilation of individual impacts of the BC-Wind OWF on seabirds during the construction phase.

Table 6.15. Significance of the project impact on seabirds during the construction phase [Source: internal materials]

Species	Impact	Impact description	Impact significance
European herring gull <i>Larus argentatus</i>	Vessel traffic	Species disturbance as a result of transportation carried out to and from the project location as well as of construction works, operation of machinery and the equipment necessary for the project implementation	Negligible
	Emission. of noise and vibrations	Presence and movement of construction vessels	Negligible
	Lighting of the project site	Attracting and gathering birds around the investment	Negligible
	Collisions with vessels	Attracting birds to vessels at night and collisions with ships	Negligible
	Barrier creation	Barrier formation by the structures of subsequent wind turbines	Negligible
	Destruction of benthic habitats	Loss of habitats due to the erection of foundations or support structures	Negligible
	Increase in the content of suspended solids in the water and sedimentation of the sediment disturbed	Disturbance of seabed sediments, especially in the case of gravity-based structures (GBS)	Negligible
Razorbill <i>Alca torda</i> , Common guillemot <i>Uria aalge</i>	Vessel traffic	Species disturbance as a result of transportation carried out to and from the project location as well as of construction works, operation of machinery and the equipment necessary for the project implementation	Moderate
	Emission. of noise and vibrations	Presence and movement of construction vessels	Moderate
	Lighting of the project site	Attracting and gathering birds around the investment	Moderate
	Collisions with vessels	Attracting birds to vessels at night and collisions with ships	Moderate
	Barrier creation	Barrier formation by the structures of subsequent wind turbines	Moderate
	Destruction of benthic habitats	Loss of habitats due to the erection of foundations or support structures	Low

Species	Impact	Impact description	Impact significance
	Increase in the content of suspended solids in the water and sedimentation of the sediment disturbed	Disturbance of seabed sediments, especially in the case of gravity-based structures (GBS)	Low
Velvet scoter <i>Melanitta fusca</i>	Vessel traffic	Species disturbance as a result of transportation carried out to and from the project location as well as of construction works, operation of machinery and the equipment necessary for the project implementation	Important
	Emission. of noise and vibrations	Presence and movement of construction vessels	Important
	Lighting of the project site	Attracting and gathering birds around the investment	Important
	Collisions with vessels	Attracting birds to vessels at night and collisions with ships	Important
	Barrier creation	Barrier formation by the structures of subsequent wind turbines	Important
	Destruction of benthic habitats	Loss of habitats due to the erection of foundations or support structures	Important
	Increase in the content of suspended solids in the water and sedimentation of the sediment disturbed	Disturbance of seabed sediments, especially in the case of gravity-based structures (GBS)	Important
Long-tailed duck <i>Clangula hyemalis</i>	Vessel traffic	Species disturbance as a result of transportation carried out to and from the project location as well as of construction works, operation of machinery and the equipment necessary for the project implementation	Important
	Emission. of noise and vibrations	Presence and movement of construction vessels	Important
	Lighting of the project site	Attracting and gathering birds around the investment	Important
	Collisions with vessels	Attracting birds to vessels at night and collisions with ships	Important
	Barrier creation	Barrier formation by the structures of subsequent wind turbines	Important
	Destruction of benthic habitats	Loss of habitats due to the erection of foundations or support structures	Important
	Increase in the content of suspended solids in the water and sedimentation of the sediment disturbed	Disturbance of seabed sediments, especially in the case of gravity-based structures (GBS)	Important
Common scoter <i>Melanitta nigra</i>	Vessel traffic	Species disturbance as a result of transportation carried out to and from the project location as well as of construction works, operation of machinery and the equipment necessary for the project implementation	Important
	Emission. of noise and vibrations	Presence and movement of construction vessels	Important
	Lighting of the project site	Attracting and gathering birds around the investment	Important
	Collisions with vessels	Attracting birds to vessels at night and collisions with ships	Important
	Barrier creation	Barrier formation by the structures of subsequent wind turbines	Important
	Destruction of benthic habitats	Loss of habitats due to the erection of foundations or support structures	Important

Species	Impact	Impact description	Impact significance
	Increase in the content of suspended solids in the water and sedimentation of the sediment disturbed	Disturbance of seabed sediments, especially in the case of gravity-based structures (GBS)	Important

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 turbines (towers, nacelles, rotors);
- cable laying (burying cables in the seabed or laying them on the seabed).

Works conducted 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 [344]. 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 [3]. They have revealed that both seasonal migratory bats and local species feed above the sea area. Based on surveys (Ahlen *et al.* [3]) carried out off the Swedish coast, it has been found that feeding was common in areas with a high density of insects above 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 the information from literature [395, 46, 3], concentrations of insects can move actively or passively with the wind.

During the construction phase, vessels and newly erected structures may serve as shelters or resting places for migratory bats [3, 397]. In that 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, the noise may cause bats to change their flight direction, which, in turn, means extra energy expenditure [124].

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 to be low, whereas the significance of the BC-Wind OWF impact during the construction phase was assessed to be 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 sites

Due to the location of the BC-Wind 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 has been established, such as biodiversity, resources, objects and elements of inanimate nature and the landscape of the Park.

In the appendix to the Regulation of the Minister of the Environment of 16 February 2017 on the protection tasks for the Słowiński National Park (Official Journal of the Ministry of the Environment 2017, item 10, as amended), in which the existing and potential internal and external hazards, as well as the methods of elimination or reduction of such hazards and their effects have been identified, a hazard has been indicated resulting from the expansion of the areas intended for the development of wind farms in the park neighbouring municipalities. In terms of potential external hazards, it has been indicated that only the erection of wind farms in the park buffer zone constitutes a potential external hazard, and thus, it should be concluded that the BC-Wind OWF shall not pose a hazard to the Słowiński National Park.

6.1.1.4.2.2 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.

6.1.1.4.3 Impact on wildlife corridors

A wildlife corridor, pursuant to the Nature Conservation Act of 16 April 2004 (Journal of Laws of 2016, item 2134, 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 [194], no wildlife corridors for the PMA were indicated in the spring and autumn periods, regular bird migrations take place in the Baltic area, however, the migration tactics and their routes are very poorly studied.

The European herring gull constituted the largest share in the seabird grouping during the spring and autumn migration periods. The abundant presence of the species was probably due to the intensification of the fishing boat operations in the area, since such high concentrations of gulls in the open sea are linked to fishing activity. The fact that fish are more available coincides with the high share of piscivorous birds (razorbill, common guillemot) in the aforementioned phenological periods.

In the case of the sea duck species analysed, i.e. the long-tailed duck, the velvet scoter and the common scoter, the increase in the number of individuals flying during the spring and autumn periods did not result in the increase in the number of individuals found sitting on the water in the area of the planned BC-Wind OWF. Moreover, during the survey campaigns in the above-mentioned phenological periods, 14 long-tailed duck individuals, 9 common scoter individuals and 2 velvet scoter individuals were recorded in total. Thus, it can be concluded with certainty that the area of the planned construction of the BC-Wind OWF does not constitute a good feeding ground for the benthivorous birds.

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 moderate. Taking into account the spatial scale of the BC-Wind 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 BC-Wind OWF on the potential migration routes of migratory species will be negligible during the construction phase.

6.1.1.4.4 Impact on biodiversity

Phytobenthos

No impacts shall occur due to the absence of phytobenthos in the OWF Area before the beginning of the project implementation.

Macrozoobenthos

The impact of the project that has the most negative character which may affect the change in biodiversity of the macrozoobenthos in the BC-WIND OWF Area is disturbance of seabed sediment structure. Physical destruction of the macrozoobenthos complex in the area of foundation and/or supporting structure installation and along the cable laying routes within the OWF Area will occur on 2.5% of the BC-Wind OWF Development Area. This will not result in a significant change in the quality structure of the soft bottom macrozoobenthos communities, consisting of taxa typical and common for the medium deep seabed and the open waters of the Southern Baltic (up to the depth of 60 MBSL).

Ichthyofauna

Impacts occurring during the construction phase may reduce the diversity of ichthyofauna through the fish deterrence caused by noise. Fish may react to an increased level of noise by leaving the affected area (avoidance reaction) [303, 295, 1]. Avoidance reaction will be stronger in the case of clupeids and cod, but it will probably affect 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 (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 depth. A local decrease in diversity may occur throughout the construction period.

Marine mammals

In the BC-Wind OWF Area and in the neighbouring sea areas, there are three species of marine mammals: the harbour porpoise, the grey seal and the harbour seal. Thanks to the application of noise mitigating measures in the form of an NRS, the BC-Wind OWF construction shall have no impact on this relatively low biodiversity, with the assumption that there shall be no more than two simultaneous piling in the BC-Wind OWF Area and/or in the area of another planned OWF.

Seabirds

The analysis of the possible impacts resulting from the construction activities conducted during the OWF construction phase indicates that their effects shall be mostly temporary and local. This applies to all types of emissions (noise, suspended solids and the release of nutrients from the sediments).

As a result of the construction works conducted, a temporary change in the species structure may occur in the BC-Wind OWF Area and the direct area around it. In the case of seabirds from the OWF Area, the most sensitive species shall be displaced already in the construction phase, and the abundance of sea ducks shall gradually decrease. An increase in the number of gulls and cormorants is expected, since they use the structures protruding from the water as their resting place. Therefore, it cannot be said that the bird biodiversity shall remain intact. It should be underlined that this change

applies to the location, in which the OWF shall be constructed and to its immediate surroundings. After the completion of the OWF construction phase and the commissioning of the wind turbines, some of the birds from the species more sensitive to the OWF impact (razorbills, sea ducks) may abandon the OWF Area and move to the neighbouring feeding grounds. Less sensitive species will remain unaffected and some species (the European herring gull, the great black cormorant), may increase their abundance at the OWF. The loss of zoobenthos in the amounts negligible from the point of view of the food resources for the seabirds shall not result in the disturbance of food relations, which shall not disrupt the existing balance and shall not lead to a permanent elimination of species.

The fragmentation of the sea habitat, in which the isolation of the populations permanently or temporarily associated with the BC-Wind OWF Area and the adjacent sea areas, shall not occur.

To sum up, the impact of the project discussed on biodiversity can be considered as low, due to the local range of this impact limited to the area occupied by the OWF including the surrounding buffer zone with a width of 2–4 km.

6.1.1.5 Impact on cultural values, 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 1 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 BC-Wind OWF project may cause the following types of impacts on the hitherto unidentified 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;
- exposure of archaeological objects;
- sedimentation of sediment raised;
- 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 BC-Wind OWF on the potential Stone Age relics will be insignificant, except for the impact related to the embedding of pile foundations, the significance of which was assessed to be low. The results of the assessment showed that the project consisting in the construction of the BC-Wind 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 geophysical surveys carried out in the BC-Wind 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);
- man-made in-ground objects;
- single stone and organic artifacts; are far more complex.

Even if the said relics potentially exist as a component of the seabed layers in the BC-Wind 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.

Appendix 1 to the EIA Report describes the wrecks found in the OWF Area, amounting to six vessels. 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 BC-Wind 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 use and development of the sea area and tangible property

During the construction phase of the BC-Wind OWF, this area will be gradually and temporarily 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 BC-Wind 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 vessel traffic related to the construction of the OWF may mean difficulties in the vessel traffic on the routes located south or north-east of the OWF.

Limitations resulting from the gradual exclusion from the previous use of the BC-Wind OWF Area will have the greatest impact on fishing, including the fisheries, as well as the necessity to extend the routes

to the fisheries located north of the BC-Wind 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 3 years – up to 5 years), this impact will be long-term and local (limited to the BC-Wind OWF Development Area).

Taking into account the previous use of the BC-Wind OWF Area for fishing and that the Applicant does not plan to apply for the limitation of fishing in the BC-Wind OWF DA, it should be assumed that the significance of the BC-Wind OWF impact on fishing will be low.

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 turbines, 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 3 years – up to 5 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 wind turbines 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 to be 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 with the distance from the OWF, the vessel traffic will increase periodically, 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 turbines 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 turbine 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 an OWF of the size such as the BC-Wind OWF, may require more than dozens of passages per year of vessels of various sizes between the OWF and the ports in the Gulf of Gdańsk (or other ports selected for construction purposes) and the ports in Łeba and Władysławowo. This will have a slight impact on the safety of navigation. During the construction period, the fishing industry will have to abandon fishing in some of the statistical rectangles: O8 and P8 in the sea areas covered by construction works.

The on-going operation of crude oil and natural gas in B3 and B8 reservoirs and the planned operation 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 BC-Wind OWF Area.

The process of the BC-Wind 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 turbines 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 Operation 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 operation 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 BC-Wind OWF infrastructure may be exposed 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 BC-Wind infrastructure components.

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

- local changes in the seabed relief associated with the presence of the BC-Wind infrastructure components and their impact on the processes of sediment transport and deposition: seabed washouts upstream/downstream of the BC-Wind infrastructure components, formation of sediment accumulation upstream/downstream of infrastructure components (sandy drifts), cavities in the seabed created at the anchoring places of the BC-Wind service vessels.

No changes in the seabed structure are expected during the project operation phase. The overall impact of the project during the operation phase can be assessed to be negligible.

6.1.2.2 Impact on the sea waters 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 BC-Wind 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 turbines 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 turbines. However, these are of local nature and should not occur outside the BC-Wind OWF Area.

Wind waves on the free sea surface, encountering obstacles in the form of wind turbine 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 [272], 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, these are of local nature and should not occur outside the BC-Wind OWF Area. The impact of wind turbines on the wave field and sea current field will be local and will not be of primary significance for these elements.

The BC-Wind 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 BC-Wind OWF will not affect these processes.

Significance of the BC-Wind OWF impact on the sea waters dynamics in the APV during the operation phase was assessed to be negligible.

6.1.2.3 Impact on the seawater and seabed sediment quality

During the BC-Wind OWF operation, 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 during their operation phase OWFs 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 operation 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 BC-Wind OWF operation, the works causing the disturbance of seabed sediments, e.g. maintenance of foundations and 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 as well as nutrients (nitrogen and phosphorus) may enter the water.

Since the seabed sediment in the area surveyed is characterised by a 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 to be negligible.

The release of pollutants and nutrients from seabed sediments during the operation phase is a direct negative impact which is local, short-term, reversible, repeatable during the operation period, and of low or medium intensity.

The significance of this impact during the operation phase in the APV was assessed to be of low importance for sea waters and negligible for seabed sediments.

Contamination of water and seabed sediments with oil derivatives during normal operation of vessels in the course of 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 turbines 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 [422]. If such solutions are applied, no significant spills outside the facility are expected.

The contamination of sea waters and seabed sediments with oil derivatives released during normal operation of vessels during the OWF operation 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 operation phase in the APV was assessed to be negligible for sea waters and seabed sediments, whereas in the 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

The contamination of water and/or seabed sediments with anti-fouling substances during the operation phase is a direct negative impact of local range, which is short-term, reversible, repeatable during the operation period, and of low intensity.

The significance of this impact during the operation phase in the APV was assessed to be 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 operation period, of low intensity.

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

Contamination of water and seabed sediments with accidentally released chemicals and waste from the OWF operation

During the OWF operation, 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 the Environment of 2 January 2020 on waste catalogue (Journal of Laws of 2020, item 10) [422]. It is necessary to comply with the procedures concerning waste handling.

The sensitivity of both receptors in the case of this impact is moderate.

The contamination of water and/or seabed sediments related to the process of the OWF operation is a direct negative impact of local range, which is short-term or momentary, non-reversible, repeatable during the operation period, and of low intensity.

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

Contamination of water and seabed sediments with compounds from anti-corrosion agents

Steel elements of foundations and/or support structures of the wind turbine and substations will corrode in the marine environment. Therefore, 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 galvanic or electrolytic protection.

Galvanic cathodic protection consists in the installation of aluminium and/or zinc anodes on foundations or support structures. The anodes gradually wear out and the aluminium or zinc is transferred to water and accumulates 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 (Zn) 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 [430].

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 [430].

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 operation, 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 their solubility in natural waters (with pH of approx. 8) is very small. They 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 BC-Wind OWF Area, which favour zinc adsorption [6, 378].

Ecotoxicity tests have shown a significant toxicity of aluminium to aquatic organisms such as algae, fish and first-order consumers [217, 290]. Excess aluminium causes decalcification and deformation of bones as well as anaemia and hardening of cellular membranes [290]. 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}) [199]. 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 [115, 290].

Zinc is one of the more mobile metals in sediments, influenced by its replaceable forms as well as its binding with organic substances [199]. It regulates the metabolism of carbohydrates and proteins in plants. Its excess ($100\text{--}400\text{ mg}\cdot\text{kg}^{-1}$ 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. On the other hand, in the case of acute zinc poisoning, there may be a shortage of copper in blood, hypocalcaemia, pancreatic inflammation, vomiting, diarrhoea and kidney damage [290].

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 durable anode materials used in this method are platinum and titanium electrodes covered with a $2\text{--}3\text{ }\mu\text{m}$ 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) emissions 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.

The contamination of the environment with aluminium or zinc released during operation 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 operation phase in the APV was assessed to be 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 temperature of the cable increases above the ambient temperature, the transfer of heat commences from the cable to the surrounding environment.

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 [357].

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 decomposition 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 [284]. 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 [284]. Both types of sediment are common in the BC-Wind OWF Area. It should be assumed that the dissipation of heat ($24 \cdot h^{-1} \cdot m^{-1}$ on the cable surface) emitted by inner-array 33 or 66 kV cables belonging to the BC-Wind OWF will be smaller than (or, at most, similar to) that recorded in the Nysted OWF.

Heating of the seabed sediment and interstitial waters may also favour the transfer of metals from the sediment to the water depth and accelerate the processes of decomposition of organic pollutants in the seabed sediment. In fact, benthic fauna is naturally adapted to large, seasonal temperature changes and is insensitive or shows very low sensitivity to a temperature increase of 2°C [33]. According to the standards proposed by the German Federal Agency for Nature Conservation, the temperature increase due to the heat emission by the OWF transmission cable in a layer 20 cm below the seabed, which is the main habitat of the infauna, must not exceed 2°C.

The heat emission above the BC-Wind 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 by the cables is a direct, negative impact of local range, which is long-term, irreversible, constant during the operation period, but due to the lack of data it is difficult to determine its intensity. There is limited number of field surveys and literature reports on operational submarine cables and the increase in temperature of seabed sediment and near-seabed water layer caused by them as well as the impact of this phenomenon on their quality.

Therefore, it is only possible to estimate the significance of this impact during the operation phase.

The significance of this impact during the operation phase in the APV was assessed to be negligible for seawater and seabed sediments.

6.1.2.4 Impact on climate, including greenhouse gas emissions and impacts relevant for adaptation to climate change, impact on atmospheric air (air quality)

Wind turbines will locally reduce wind energy and disturb atmospheric pressure directly in the area of the rotor operation. The wind turbine 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 between the BC-Wind OWF Area and the shore as well as 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 operation will be minimal (coming mainly from 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 operation 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 BC-Wind OWF from a renewable source at the level of 500 MW, which in the case of carbon dioxide emission of the conventional old-type electricity generation at the level of 900–960 kg of CO₂ per 1 MWh will enable a noticeable reduction of gas emissions in Poland.

According to the findings of the GP WIND project [141], the production of electricity from OWPS is associated with the emission of 6 to 34 kg of CO₂ per 1 MWh in all phases of the OWF existence, which, with the expected production of 55.85 TWh during 25 years of operation, means the emission of 0.34 to 1.90 million Mg of CO₂. 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 generated from other sources e.g. fired with hard coal or lignite (emission reduction of over 20 million Mg of CO₂ are expected – without taking into account the emissions related to the construction of these sources).

During the operation phase, local greenhouse gas emissions will slightly increase as a result of fuel combustion by service vessels carrying out maintenance services of the OWF, but their impact will be compensated by the reduction of emissions in the generation of energy from wind.

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 operation of the BC-Wind 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 turbines. However, it should be noted that in order to ensure proper operation of the OWF, it is necessary to take into account the possibility of extreme weather conditions at a scale greater than the currently observed one, 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.

For open sea areas, the shortening and easing of ice periods will have a beneficial impact on shipping conditions and the operation of the equipment at sea.

Progressing eutrophication of sea waters may cause some difficulties in the operation 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 operation 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 operation of the OWF 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 BC-Wind OWF impact in the Applicant Proposed Variant during the operation 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 operation of offshore wind farms so far that the operation of wind turbines 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 BC-Wind 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 sailing near the BC-Wind 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 (Great Britain) on navigation radars and other navigation support facilities (navigation buoys, RACON marking), QinetiQ carried out surveys in 2010 [509]. The following scenario of activities in the OWF area was adopted:

- 240 wind turbines with a power output of 8 MW (maximum number and capacity of the wind turbines);
- 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 turbines 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 turbine 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 turbines for S-band radars and at a distance of 1 NM (1.8 km) from wind turbines 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 turbines), the level of interference may result in the reduction of the detection capability by approx. 29%. It should be expected that for the BC-Wind 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 turbine 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 BC-Wind 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/7/12 and no. MFW/4/13, 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 BC-Wind 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 the BC-Wind 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 BC-Wind 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 turbines (shape of blades, towers and nacelles of wind turbines 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 offshore area

6.1.2.6.1.1 Phytobenthos

During the operation phase, support structures of wind turbines and the accompanying infrastructure located under the water surface in the euphotic zone may be overgrown by macroalgae [34, 36, 179, 221, 246, 301, 337, 516, 503, 212, 47, 377].

Despite the lack of underwater vegetation in the area of the planned OWF, various natural and anthropogenic factors may cause the emergence of macroalgae in this area. The first group of factors should include the transport of spores which are carried by sea currents from the areas of macroalgae occurrence [311, 476, 135, 56]. The spores may also be released by macroalgae thalli brought by sea currents from their original habitats, after breaking off from the seabed during storms [311, 131].

The anthropogenic factors should include the transport of spores in ballast waters of vessels [130, 255], e.g. vessels involved in the construction and maintenance of the OWF infrastructure. They can also originate from the macroalgae growing on the hull of vessels [248, 311].

It should be presumed that the macroalgae spores are present in the OWF Area 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 may 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 filamentous thalli appear first, to be displaced by species with compact thalli [246].

Currently, it is impossible to determine which macroalgae species will grow on the OWF structures. However, certain indications can be found in the research carried out for the Utgrunden 1 OWF located in the southern part of the Kalmar Strait [57]. In 2007, i.e. 7 years after the commencement of the OWF operation the presence of filamentous green algae (*Cladophora* sp.) and red algae (*Ceramium tenuicorne*, *Polysiphonia fucoidea* and *Rhodocorton purpureum*) was found on the support structures of wind turbines. The example of *C. tenuicorne* indicates that among the macroalgae growing on structures, there may also be species subject to strict protection pursuant to 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 and balanuses) overgrowing the OWF components create the "artificial reef", an element 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 suitable for a refuge and reproduction within it [7, 9, 508, 507, 504, 255]. 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.

In conclusion, the significance of the impact was considered positive and negligible.

6.1.2.6.1.2 Macrozoobenthos

The operation of the BC-Wind OWF will result in the following impacts on the macrozoobenthos inhabiting this area:

- the loss of a fragment of macrozoobenthos habitat;
- an "artificial reef" effect.

The most important technical parameters of the OWF [Table 6.3] which are important from the point of view of the assessment of the project impact on macrozoobenthos during the operation phase are:

- the OWF Development Area;
- wind turbine foundations – type, number and shape of foundations covering the seabed.

The assessment of the wind turbines impact in the BC-Wind OWF Area (1 NM) during the operation phase was carried out separately for:

- the soft bottom macrozoobenthos;
- the hard bottom macrozoobenthos.

A separate assessment of the project impact on macrozoobenthos is the result of these two benthic fauna communities (from the soft and hard bottoms) differing in the taxonomic composition, abundance and biomass of their taxa. Consequently, they differ in significance and sensitivity regarding

the various types of impact. The significance and sensitivity of the group of organisms assessed (the soft and hard bottom macrozoobenthos) together with the evaluation of the impact scale (nature of interactions, type of interactions, spatial extent, time scope) influence the assessment of a given impact significance.

The significance of the macrozoobenthos complex from the soft bottom is low while the significance of the macrozoobenthos complex from the hard bottom is high [subsection 6.1.1.4.1.2]. The definition of macrozoobenthos sensitivity is provided in Table 6.4.

Loss of a part of the habitat for the macrozoobenthos is the main impact at this stage of the project [221, 337, 516]. The seabed development will eliminate life from the sediment surface area occupied by the offshore wind turbine foundations. In the worst-case scenario, this will be the seabed surface occupied by the GBS with the largest base diameter from among the possible types of support structures with a scour protection layer. The foundations will occupy the seabed during the entire period of the OWF operation. At the same time, the wind turbine foundations together with the anti-scour layer will modify the velocity distribution of the surrounding sea currents. As a result of changes in hydrodynamic conditions, the grain distribution of seabed sediments may change in the direct vicinity of the foundations. This will, in turn, entail the shift in the quantitative and qualitative structure of the zoobenthos complexes where the benthos has not been completely destroyed [96].

Estimated calculations indicating the amount of the lost macrozoobenthos resources in the Development Area of the BC-Wind OWF are presented below.

According to the APV, a permanent loss of habitats with macrozoobenthos complexes under 41 GBSs will occur on a very small surface area of 0.12 km², which constitutes only 0.13% of the Development Area (88.92 km²). In this study it has been assumed that the hard bottom covers maximally 5% of the OWF Area, thus taking into account also the assumption that the foundations and/or support structures of the wind turbines will be evenly distributed (39 foundations and/or support structures on the soft bottom and 2 on the hard bottom), the loss of the soft bottom macrozoobenthos habitat will cover 0.11 km² (0.12% of the development area) and the loss of the hard bottom macrozoobenthos habitat – only 0.01 km² (0.01% of the development area).

The sensitivity of both the soft and hard bottom macrozoobenthos complexes to this impact is high, as a part of the benthos complex will be permanently destroyed due to the impact of stress factor acting throughout the entire operation phase.

Additionally, when assessing a high-significance impact on the hard bottom macrozoobenthos complex, it should be taken into account that an important component of the fish food supply will be eliminated from the environment. In the case of the BC-Wind OWF Area, no significant changes will take place in the food chain regarding the links between birds and benthos. Due to a large depth of the sea area (27.7–65.2 m), sea ducks have a limited access to the food such as the *Mytilus trossulus* mussels; hence, the long-tailed duck or the velvet scoter are present there in limited numbers and the dominant bird species are the European herring gull, the razorbill or the common guillemot that prey on pelagic fish (Appendix 1 to the EIA Report). Permanent destruction of the bay mussel *Mytilus trossulus* aggregation may occur only on the surface of 0.01 km² which corresponds to a biomass of approx. 20 800 kg, with an average biomass of the hard bottom macrozoobenthos of approximately 2080 g·m⁻², with the bay mussel (*Mytilus* sp.) share in this complex being more than 99%.

The loss of a part of the habitat is a negative impact occurring during the operation phase, however due to the local range limited to just 0.13% of the BC-Wind OWF Development Area, which is a small

value, the scale of this impact will be low. The significance of impact on the soft and hard bottom macrozoobenthos complexes has been assessed to be low [Table 6.16, Table 6.17]. Besides, as regards the complex comprising the bay mussel *Mytilus trossulus* aggregations, despite their loss due to the laying of wind turbine foundations, these mussels typically are the first and quick to re-colonise the underwater parts of the wind turbines and their surrounding seabed environment during the OWF operation phase.

Table 6.16. Assessment of the impact of wind turbines on the soft bottom macrozoobenthos in the BC-Wind OWF Area (1 NM) during the operation phase [Source: internal materials]

Impact	Characteristic of the soft bottom macrozoobenthos complex		Scale (size) of impact					Impact significance
	Significance	Sensitivity	Character	Type	Spatial range	Time span	Size	
Loss of a fragment of the habitat	Low	High	Negative	Direct	Local	Long-term Permanent	Low	Low

Table 6.17. Assessment of the impact of wind turbines on the hard bottom macrozoobenthos in the BC-Wind OWF Area (1 NM) during the operation phase [Source: internal materials]

Impact	Characteristic of the hard bottom macrozoobenthos complex		Scale (size) of impact					Impact significance
	Significance	Sensitivity	Character	Type	Spatial range	Time span	Size	
Loss of a fragment of the habitat	High	High	Negative	Direct	Local	Long-term Permanent	Low	Low

The “artificial reef” effect is the colonisation of hard artificial substrates of supporting structures introduced to the environment by animal and plant periphyton complexes and by mobile epifauna. Despite the fact that this impact is widely documented in the literature (e.g. [34, 246, 33, 503, 212, 47, 377, 193, 29, 279, 258, 502]), so far no OWF was built in the PMA of the Southern Baltic and there was no possibility to monitor the “artificial reef” phenomenon [28, 452, 453, 346]. Only experimental research was conducted on an artificial structure installed in the environment [110].

Based on literature, it is known that in the location where the hard substrate had not been previously present, the quantitative and qualitative structure of the zoobenthos complex will change within the entire microhabitat, i.e. on the surface of underwater structures and on the surrounding seabed. 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. This depends on the local environmental conditions, reproductive potential of zoobenthos organisms and ecosystem management plans in the BC-Wind OWF Area [29, 279, 315].

On the one hand, this is a positive phenomenon, since there will be an increase in local biodiversity 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 trossulus*) aggregations, a dominant species in the open waters of the Baltic Sea, 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 [487, 503, 240, 29, 279].

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. Furthermore, the presence of underwater, hard structures will constitute a new microhabitat contributing to the increase in biomass of the gelatinous zooplankton (medusae) whose polyps (settled form) attach to hard structure surfaces [193]. However, primarily it is an artificial environment which was created in the place of the natural sandy and gravelly seabed that is conducive to propagation of invasive foreign species that are not native to the PMA [63, 57]. On the basis of the surveys carried out as part of the “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 (molluscs, crustaceans). The information on new foreign species is collected on an on-going basis in various databases, e.g. AquaNIS. Editorial Board 2015 (<http://www.corpi.ku.lt/databases/index.php/aquanis>) or Ballast Water Exemption Decision Support Tool (http://jointbwmexemptions.org/ballast_water_RA/apex/). The invasive foreign species quickly displace indigenous species, leading to changes in the existing balance in the trophic network [192, 310, 238]. Currently it is a very serious problem in the Southern Baltic that poses a risk to biodiversity and, consequently, changes in the structure and functioning of the inhabited ecosystems. This negative impact may also indirectly affect the economy, i.e. it may cause losses in the fishing and aquaculture industries [463, 238]. However, the areas particularly at risk of introduction of foreign species are sea ports which are the destinations of ships with ballast tanks and hulls carrying various kinds of plant and animal species as well as pathogens brought from all over the world [238].

An unambiguous scenario of colonisation of artificial substrates during the operation phase in the BC-Wind OWF Area is difficult to predict. Based on experimental research [110] it is assumed that

underwater structures will be firstly colonised by barnacles (*Amphibalanus improvisus*) and bay mussels (*Mytilus* sp.), followed by mobile crustaceans (such as *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 operation phase, monitoring will be necessary to further investigate the “artificial reef” effect. This will also verify whether foreign species found mainly in the ports visited by transatlantic ships spread by plankton larvae and settle on the hard, artificial substrate in the open water zone of the Baltic Sea. It is assumed that this effect is unlikely, since the BC-Wind OWF will be located approx. 25 km away from the land and will comprise 41 wind turbines in the APV and 62 wind turbines in the RAV. On the other hand, also other OWFs will be located near this farm, thus expanding the surface area of the new “artificial reef” in the PMA.

It should be noted that for this impact, it is not the original complex of benthic communities of the BC-Wind OWF which is evaluated but the evaluation pertains to the impact of the “artificial reef” on the natural environment. It is possible to evaluate only the scale of this phenomenon. The “artificial reef” effect will be a long-term and permanent phenomenon, but due to its local range, the impact was considered moderate [Table 6.18].

Table 6.18. Assessment of the “artificial reef” effect on the ecosystem in the BC-Wind OWF Area (1 NM) during the operation phase [Source: internal materials]

Impact	Scale (size) of impact					Impact significance
	Character	Type	Spatial range	Time span	Size	
“Artificial reef” effect	Positive May also be negative	Direct	Local	Long-term Permanent	High	Moderate

6.1.2.6.1.3 Ichthyofauna

During the BC-Wind OWF operation 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 sound generated by the operating wind turbines is characterised by low frequency, usually not exceeding 1 kHz. The level of noise depends mainly on the distance from the wind turbine. To a lesser degree, it depends also on the size of the structure and the strength of wind. Studies cited by Kikuchi (2010) indicate that differences between noise levels generated by turbines operating at different wind speeds (from 3.5 to 17 m·s⁻²) do not exceed 30 dB. The maximum noise level generated by an operating wind turbine was measured to be 137 dB re 1 Pa at a distance of 40 m. Thus, it is much lower than the noise observed during piling and lower or comparable to one generated by vessels. Also, the cumulative noise for the entire OWF shall remain at a level lower than the one generated by the traffic of large vessels [457].

The impact of noise at the OWF operation stage should be much lower than the one observed during construction and decommissioning. Its possible effect can be behavioural responses. According to Thomsen *et al.* [448], the sound generated by operating wind turbines will be audible to salmon and common dab at a distance of approx. 1 km, while for cod and herring at a distance of up to 4–5 km. The maximum range of the masking effect (interference with sound perception) should be close to the range of audibility. However, for herring, it is likely to be much smaller [448]. The effect of avoiding the areas located in the immediate vicinity of the wind turbine is probable, however, the extent of this impact should not exceed a few metres. According to Wahlberg and Westerberg [488], the response involving the avoidance of increased pressure related to the sound generated occurs in the zone up to 4 m away from the wind turbine. Observations carried out in the area of one of the Swedish OWFs showed no changes in behaviour of eels swimming at a distance of 500 m from the operating wind turbine. On the other hand, the experimental research conducted in aquaria [299] demonstrated plaice and cod reaction to noise generated by wind turbines. However, it was not strong enough to result in a permanent habitat abandonment.

The comparison of common roach and cod catches in the vicinity of the non-operating wind turbines showed a significant accumulation of fish in the immediate vicinity of the structure (100 m), which can be attributed to the artificial reef effect. However, in the case of an operating wind turbine, the catch volume decreased twice in the area. Such result can be interpreted as the effect of the noise emitted, but other causes cannot be excluded [496, 448]. The results of many studies documenting the aggregation of fish in the direct vicinity of wind turbines (discussed in the subsection on the artificial reef effect), indicate that the level of noise generated by the operating wind turbines is not sufficient to play a deterrent role [477]. However, due to the lack of studies, the possible negative effect of fish prolonged exposure to sound cannot be excluded.

Another source of noise occurring in the operation phase may be the increased traffic of vessels supporting the OWF. Responses involving the avoidance of vessels sailing by was recorded in the case of surveys conducted on the Baltic populations of cod, herring and sprat, which indicate the best

acoustic reception among the main species exploited by fishery [187]. In the case of herring, the avoidance of sound sources related to the traffic of vessels and fishing gear was usually observed outside the reproductive season [317, 475], whereas, in the spawning period, this stimulus was not significant enough to elicit such a response. According to Thomsen *et al.* [448], there are no scientific grounds for determining the universal noise level of vessels, above which it would be detrimental to fish.

The BC-Wind OWF Area is neither a spawning ground of cod nor of 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 operation may directly and negatively affect the ichthyofauna. These 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 for the common seasnail as moderate.

The significance of the impact is assessed to be negligible for all the fish species analysed.

Habitat change

The presence of structural elements of wind turbines involves the creation of additional hard substrates forming a new habitat. According to Petersen and Malm [337], its occurrence in the environment is one of the most significant impacts of an OWF. Such structures constitute the so-called artificial reef – a new habitat that can be inhabited by organisms. The scale of this phenomenon depends both on the size of the area in which the underwater parts of wind turbine structures and other infrastructure elements are placed, the surface and complexity of its structures, as well as the environmental conditions in which it was constructed and the ichthyofauna composition in its area [159]. It should be underlined that this case is unique, since the hard habitable surfaces are located not only on the seabed (horizontal elements of foundations and scour protections), but are present also in the water depth up to the water surface (wind turbine towers) [97]. At the project design stage, it is possible to enhance the artificial reef effect by using materials and structural solutions expanding the structure surface available to organisms, for example, scour protection around foundations [143].

At the first stage, the reef becomes inhabited by periphyton organisms, macrophytes and invertebrates [111]. Already several months later, numerous populations of fish [455, 426] appear in the reef area, both those returning after the cessation of the disturbances related to the construction [362] as well as those not present in this area so far (increase in biodiversity). According to Kerckhof *et al.* [213], after 6 years, we can speak about a fully developed complex of organisms inhabiting the artificial reef (climax community).

Artificial reef is an attractive habitat which can offer rich food supply, shelter and create favourable conditions for reproduction for many fish species. Extensive hard structures (e.g. submerged structural elements of a wind turbines) are attractive shelters for young (2–3 years old) cod (*Gadus morhua*) [365]. They are sheltered from sea currents, predators [41, 505] and fishing pressure. The studies by Reubens [364] which compared the fish catch efficiency of cod and bib (*Trisopterus luscus*) on a sandy seabed in the regions where an artificial hard substratum was present (wrecks, OWFs), have indicated

a distinct grouping of these species in the project area, especially in the periods of intense feeding (summer, autumn). On the other hand, the studies conducted by van Hal [477] in area of a Danish OWF located in the North Sea, have shown a regularity of fish distribution at a microscale within the area of the OWF itself. Cod, bib and shorthorn sculpin (*Myoxocephalus scorpius*) were found to concentrate in the immediate vicinity of wind turbines, while flatfish preferred sandy seabed areas between the turbines.

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*) [516]. According to Jensen *et al.* [195], the artificial reef area also provides preferable spawning conditions for gobies, which include species protected in Poland.

The studies by Bergström *et al.* [30] in the area of the “Lillgrund” OWF located in the Sound strait showed a visible aggregation in the area of the project of fish species such as cod, shorthorn sculpin, black goby, viviparous eelpout and eel. 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 [425].

The assessment whether the artificial reef effect is limited only to attracting fish from the surrounding sea area, or whether there is an actual production of additional biomass is a matter of an ongoing discussion that cannot be resolved without further extensive research [339]. The results of studies conducted by Reubens *et al.* [364] in the area of Belgian OWFs located in the North Sea, have shown not only an aggregation of cod in these areas, but also an increase in the local production. However, it was limited to the area in the immediate vicinity of the OWF, and it was not visible at a regional scale.

One of the conditions necessary for the actual increase in fish biomass caused by the artificial reef effect is the provision of a sufficient amount of food in the area. The fulfilment of this condition in the case of the OWF in the Belgian part of the North Sea is confirmed by the studies of De Troch *et al.* [93]. These demonstrate that the OWF areas constituted good feeding grounds for both cod and bib, and that the food resources were sufficient enough for the food competition not to occur. The Reubens’ observations [366] also confirm the good condition of both these species in the area of the artificial reef.

The results of ecological modelling confirm the increase in the environmental capacity in the area of the artificial reef located near the coast of Portugal. This resulted in a significant increase in the biomass of fish from the two banded sea bream (*Diplodus vulgaris*) species in this area [368]. However, according to Bohnsack [40] in many cases, the presence of an artificial reef involves only the aggregation of fish in its area, and not an increase in biomass.

In the case of limitations introduced for fishery and navigation in the areas occupied by the project (e.g. OWF), the anthropogenic pressure shall decrease. As a result, the areas of artificial reefs may become a particular refuge for fish, both adult and their early developmental stages (larvae and fry), becoming an equivalent of the protected areas [95]. Hammar *et al.* [159] even state that in some cases the OWF areas may become a protection tool as effective as the Marine Protected Areas, provided that adequate fishing restrictions are introduced in the area. In such a situation, even if the artificial reef does not increase the capacity of the environment, it may contribute to the increase of the production of certain fish species in its vicinity by reducing fishing mortality [366].

If there are no restrictions on fishing in the OWF Area, 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 areas adjacent to the OWF [399].

It is possible that artificial reefs offering environmental conditions significantly different from those occurring in a given area beforehand may constitute an environment facilitating invasion of foreign species [244]. However, the information available in literature concerns mainly the appearance of periphyton organisms and crustaceans. However, it cannot be ruled out that artificial reefs may create an environment that also favours non-native 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, for example, 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 Gulf of Gdańsk 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 coastal shallow water zone, in the Pomeranian Bay and in the Vistula Lagoon and its tributaries.

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 [489, 401]. Therefore, it can be assumed that the OWF Areas located usually in deeper sea regions shall not be an area appropriate for the breeding 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 [412].

The impact of the formation of a new habitat was assessed by Bergström *et al.* [29] as positive, and its level as moderate.

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 analysed.

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 [424].

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 is assessed to be negligible for all the fish species analysed.

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. Depending on the cable type and the depth of its burial 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 [113].

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) [113].

The magnetic field detection threshold is, depending on the species, between 0.01 and 0.05 μT .

The natural Earth's magnetic field is used by fish during migrations and also provides guidelines for the identification and localisation of resources [182]. Its interferences by the anthropogenic electromagnetic fields can have important ecological consequences.

According to Taormina *et al.* [438], 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. However, the previous field surveys do not indicate a significant impact of this factor on the migration capabilities of this species. In the surveys conducted in the Southern Baltic, no disturbances in the migration of eels swimming 500 m away from a wind turbine have been observed [314]. Also, Westerbeg and Begout-Anras [497] did not find that the high-voltage DC cable constituted a barrier to migration of this species. Only a decline in the speed of swimming was observed in the zone near the cable, however, it was insignificant, causing an approx. 30-minute delay in the completion of the migration route [314]. Studies on the impact of the magnetic field generated by the submarine cable in the San Francisco Bay area on the migration of Chinook salmon (*Oncorhynchus tshawytscha*) have not indicated a significant impact of this potential source of interferences on the migration route, although its route was slightly changed [141].

The studies conducted by Bocherta and Zettlera [39] did not indicate a significant impact of the prolonged exposure to an increased permanent magnetic field on flounder. Also, during the experimental surveys on the halibut's response to electromagnetic field, no significant changes in the behaviour of these fish were observed [508].

The extensive surveys on the impact of cables running across the Nysted OWF Area (the Danish straits) on ichthyofauna have indicated that although they constitute no barrier for fish, however, they can be an obstacle to their movement, especially the migration of eel. The authors of the report conclude that although changes in the behaviour of fish along the cable route have been observed, their cause-and-effect relationship is unclear [90].

Research on the impact of 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) [268]. 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 [128], thus, at values significantly exceeding the ones generated by submarine cables.

The BC-Wind OWF Area is neither a spawning ground of cod nor of 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.

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 is assessed to be negligible for all the fish species analysed.

6.1.2.6.1.4 Marine mammals

During the BC-Wind OWF operation phase, the impacts on marine mammals will result from:

- emission of noise generated by wind turbines;
- emission of noise generated by vessels;
- changes in the habitat;
- leakage of oil derivatives into the environment due to vessel breakdowns;
- their collisions with vessels.

Noise generated by wind turbines

Underwater noise generated during the OWF operation phase mostly comes from the vibrations of the generator and the gearbox, transmitted through the foundation and/or support structures to the water. It is much lower than the noise generated during the OWF construction phase as a result of pile driving [31, 445, 456]. However, it should be emphasised that the emission of noise generated by wind turbines shall occur throughout the entire project duration, which may exceed even 20 years.

The knowledge from before 2006 on the noise generated during the OWF operation has been summarised by Madsen *et al.* [261] and Thomsen *et al.* [448]. In both studies, it has been shown that the existing OWFs increase the level of ambient noise only to a very limited degree, and in consequence, their impact on marine mammals was assessed to be low.

In 2007, Nedwell *et al.* [304] conducted a survey campaign of the following OWFs in the operation phase: North Hoyle, Scroby Sands, Kentish Flats and Barrow located in the UK (with the pile diameters of 4–4.7 m). It was concluded that the environment of the OWF at the operation phase was characterised by sound levels higher by approx. 2 dB with reference to fish, than in the waters with no operating OWFs. On the other hand, no differences were found in the case of marine mammals. On the basis of these studies, it was concluded that the noise generated during the OWF operation was very low and no evidence was found that the noise had reached a level that would contribute to the avoidance of these areas by marine mammals [304].

Tougaard *et al.* [456] measured the operational noise from three smaller wind turbines (0.4–2 MW) at three OWFs – Middelgrunden and Vindeby in Denmark as well as Bockstigen-Valar in Sweden. Wind turbine noise was measured only above the ambient noise level for the frequencies below 500 Hz, which are generally poorly heard by marine mammals [446]. They have discovered that with the increase in the wind speed only the peak noise levels increased, and not the frequencies, because the wind turbines were maintained at constant rotation, which confirmed that the noise is generated mainly by the gearbox. They have also estimated the very small range of the noise perceived by harbour porpoises (<100 m), whereas, depending on the propagation losses adopted, the audibility for seals was from 2.5 to 10 km from the sound source.

Marmo *et al.* [269] modelled the acoustic power of the operating OWFs and its dependence on the type of foundation structure used (jacket structure, large-diameter pile and gravity-based foundation). The vibrations generated by a typical wind turbine with a power of 6 MW was modelled in the frequency band from 10 Hz to 2 kHz. The results of these model calculations indicated that the sound fields had tonal tendency with peak levels of sound pressure (SPL) related to the gearbox intermeshing frequencies and the electromagnetic interactions in the generator. The conclusions from those studies were the following: harbour porpoises can detect monopile foundations during the OWF operation, at a distance of at least 18 km, and the jacket foundations in the 630 Hz band at wind speeds of 10 and 15 ms⁻¹ only at a distance of 4 and 11 km, respectively. On the other hand, seals are unable to detect operating wind turbines in the frequency band below 100 Hz, regardless of the wind speed and the type of foundation. However, they can detect an operating wind turbine in the 1/3 octave bands between 120 and 630 Hz in all wind conditions at a distance of up to at least 18 km [269]. However, the scopes have been based on the ambient noise levels from the study by Wenz [495], which is a very cautious approach, because such levels are characterised by low energy and probably are not representative for shallow waters, such as the ones in the planned area of the BC-Wind OWF project.

As part of the MarVEN project [445], surveys were conducted at two Belgian OWFs with 3 MW wind turbines on large-diameter steel piles (Belwind and Northwind) and a single OWF with 5 and 6.15 MW wind turbines on jacket foundations (C-Power OWF) [445]. The recordings showed peak sound values at 50, 150, 400, 500 and 1200 Hz in the 1/3 octave spectrum. The surveys were conducted at several distances from the source, and the values recorded for the Northwind OWF wind turbine were compared with the measurements from the C-Power OWF. The values of the noise measured were significantly higher for Northwind, when the distance increased to 150 m, which also suggests that the foundation type may be a factor contributing to the level of noise generated by wind turbines, especially at greater distances.

One of the most comprehensive studies on the noise generated during the OWF operation was the RAVE programme (Research at Alpha VEntus), in which the operational noise of Alpha Ventus OWF in the North Sea was measured for 165 days in 2010 and 2011 [31, 478]. The analysis focused on the noise from two operating wind turbines of different manufacturers, each with a rated power of 5 MW. For one of the wind turbines, a very characteristic tonal noise was measured with a frequency of 90 Hz with harmonics at 450, 630 and 810 Hz [Figure 6.1], which dominated in the operational noise of the OWF, especially at full operational load. However, contrary to the expectations, this project demonstrated that in the OWF Area, noise level decreased with the increasing wind speed and power output, because the ambient noise (e.g. from the distant vessels) was suppressed due to the increased sea state and this decrease compensated for the increase in the wind turbine noise. On the basis of this study, Betke [31] suggested also that although the noise levels may increase with the increase in the wind turbine size, they are likely to be outside the frequency range audible for marine mammals.

In 2020, Tougaard *et al.* [457] carried out a review of the noise measurements published from the OWFs exploited. The sound source levels were at least by 10–20 dB lower than the noise emitted from the vessels in the same frequency range. Moreover, the factor of distance from the operating OWF turned out to be the most important variable explaining the sound levels measured with a smaller effect of the wind speed and wind turbine size.

The noise levels from the studies described above have been standardised to a distance of 25 m and are summarised in Table 6.19.

Table 6.19. Recorded noise levels standardised to a distance of 25 m. Water depths refer to the depths measured for wind turbines, the entire OWF or the measurement point, and are used only for the reference purposes. 1/3 octave central frequencies refer to the maximum sound pressure level of 1/3 octave. Distances relevant for the sound pressure given were adopted as the measurement distances. If the noise level has already been specified (e.g. for Alpha Ventus), the value is presented below. In the case of North Hoyle, Scroby Sands, Kentish Flats and Barrow OWFs, the measurements conducted in the OWF Area or outside the area have been adopted [Source: internal materials]

Offshore Wind Farm	Wind turbine rated power [MW]	Water depth [m]	Maximum level of the broadband sound pressure at a distance of 25 m [dB re 1 µPa]	Maximum levels of a 1/3 octave band at a distance of 25 m [dB re 1 µPa]	1/3 octave band central frequency [Hz]	Measurement distance [m]	References
Vindeby	0.45	4	120	120	125	14	Tougaard <i>et al.</i> [456]
Bockstigen-Valar	0.5	10	109	106	160	20	Tougaard <i>et al.</i> [456]
Utgrunden	1.5	-	-	118	160	1	Thomsen <i>et al.</i> [445]
Middelgrunden	2	5	105	102	25	20	Tougaard <i>et al.</i> [456]
North Hoyle	2	12	125	-	-	In the OWF Area	Nedwell <i>et al.</i> [304]
North Hoyle	2	12	117	-	-	Outside of the OWF	Nedwell <i>et al.</i> [304]
Scroby Sands	2	5	127	-	-	In the OWF Area	Nedwell <i>et al.</i> [304]
Scroby Sands	2	5	129	-	-	Outside of the OWF	Nedwell <i>et al.</i> [304]
Northwind	3	20	135	-	-	40	Thomsen <i>et al.</i> [445]
Northwind	3	20	142	-	-	150	Thomsen <i>et al.</i> [445]
Kentish Flats	3	5	111	-	-	In the OWF Area	Nedwell <i>et al.</i> [304]
Kentish Flats	3	5	110	-	-	Outside of the OWF	Nedwell <i>et al.</i> [304]
Barrow	3		121	-	-	In the OWF Area	Nedwell <i>et al.</i> [304]
Barrow	3		119	-	-	Outside of the OWF	Nedwell <i>et al.</i> [304]
Alpha Ventus	5	30	-	123	90	1	Van Radecke I Benesch [478]
C-Power	5	25	137	-	-	40	Thomsen <i>et al.</i> [445]
C-Power	5	25	131	-	-	60	Thomsen <i>et al.</i> [445]
C-Power	5	25	131	-	-	150	Thomsen <i>et al.</i> [445]

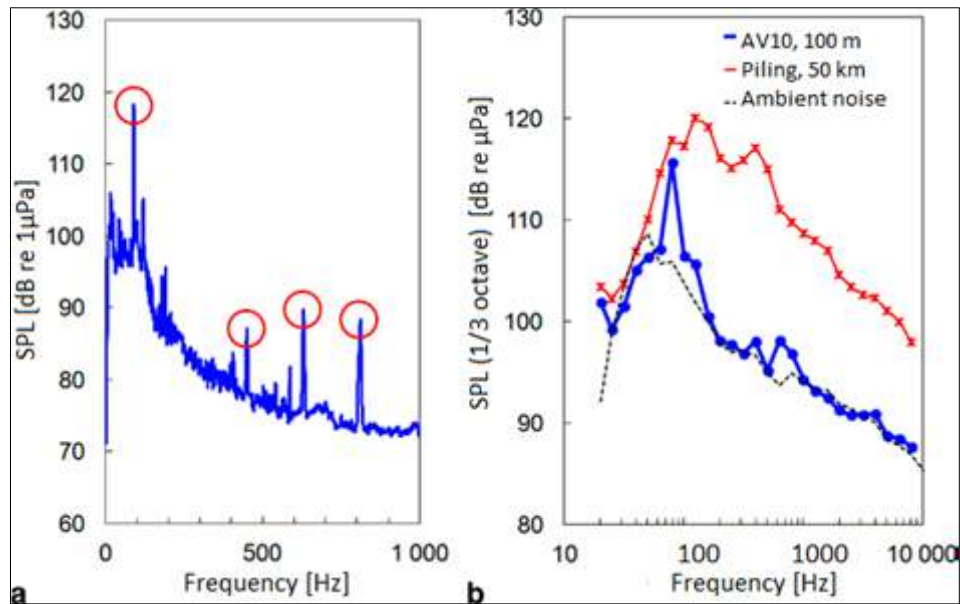


Figure 6.1. Noise from a 5 MW wind turbine measured at a distance of 100 m from Alpha Ventus OWF: a) noise spectral density – red circles indicate tonal component at 90 Hz and harmonics at 450, 630 and 810 Hz; b) noise spectrum in 1/3 octave bands from the figure a (blue line), ambient noise at the same wind speed and without the wind turbine operation (dashed line), and the noise from a distant piling (red line) [31] [Source: internal materials]

Although harbour porpoises and seals can detect noise generated as a result of the OWF operation, the abundance of marine mammals does not necessarily decrease in comparison to the abundance from before the construction phase, when the animals are exposed to much higher noise levels. As has been already mentioned in subsection 6.1.1.4.1.4, Scheidat *et al.* [403] demonstrated that after the OWF construction phase in the Dutch waters (Egmond aan Zee), harbour porpoises returned to the OWF Area during operation in even larger numbers than to the surrounding control areas. They have suggested that the OWF Area in which the traffic of vessels and trawling were banned may have constituted a shelter and an opportunity for feeding in comparison to the locations with increased navigation. In the southern part of the North Sea, in which the OWF is located, the abundance of the harbour porpoise generally increased [334, 446]. The increase in the number of animals may have simply followed a more general trend, which was not related to the OWF. However, no similar increase in the harbour porpoise abundance has been observed in the reference areas. In the course of another study, a 10-year monitoring period [439], a strong decrease in the harbour porpoise detection has been determined after the Nysted OWF construction on the Danish part of the Baltic Sea. The harbour porpoise detection level returned to 29% of the initial level probably thanks to the positive effects accompanying the OWF (e.g. the artificial reef effect). On the other hand, Teilmann *et al.* [441] have not confirmed that the presence of wind turbines impacted the number of harbour porpoises in the Rødsand II OWF Area, which is located in the vicinity of the Nysted OWF. However, it should be mentioned that at Nysted, the harbour porpoise acoustic activity (number of detections) has been relatively low from the beginning. Therefore, these results may not be representative due to the small sample sizes. Summing up, various types of OWFs in various environmental conditions may have different impact on the distribution of harbour porpoises within a particular area.

The impact of the OWF operation has also been studied in the context of the impact on seals. Russell *et al.* [392] indicated that several marked harbour seals actively sought the foundations or support structures of wind turbines 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. What is more, Russell *et al.* [393] have discovered that within the framework of the OWF operating in the North Sea, an almost statistically significant (at 5%) increase in the use of the area by seals occurred, compared to the period before the construction of the OWF (increase in the proportion of seals occupying the area analysed from 0.01–1.16% to 0.54–2.82%). In another study, McConnell *et al.* [274] have recorded that the seals totally ignored the Nysted and Rødsand II OWF structures, suggesting that, similar to harbour porpoises, seals did not appear to be deterred from OWFs, and under certain conditions their locations were attractive to them.

It should be added that the noise levels and impacts discussed above apply to gearbox turbines. However, the latest turbines operate in the direct-drive technology. Because the gearbox belongs to the main sources of sound, it is expected that the turbines with a direct-drive shall generate lower noise levels, especially under water, where the sound generated by blades plays a minor role. Consequently, the impact of the BC-Wind OWF project during the operation phase may be even lower than the one described above.

Therefore, the impact of noise generated during the OWF operation phase in the case of the harbour porpoise, the grey seal and the harbour seal shall be low.

Noise generated by vessels

It is likely that small- and medium-sized vessels will be used to service and maintain the BC-Wind OWF. Vessels of this type emit sounds mainly between 160–180 dB re 1 µPa at 1 m, covering the frequencies from <1 kHz to >10 kHz. It is possible that this will lead to the increase in the local acoustic field during the OWF operation, including frequencies that are partly significant for marine mammals. The total number of the OWF service and maintenance works is not known so far. However, it is possible that only one ship will be used at a time. Therefore, the increased sound field shall be rather limited to a local and short-term one, thus, the significance of the impact may be considered as low for marine mammals.

Changes in the habitat

The visual impact of the exploited OWF shall be probably minimal under water. The underwater parts of the foundations and/or support structures become quickly overgrown, resembling other reef structures found in the sea. Above the sea surface, OWFs constitute a significant change in the surrounding landscape, however, so far it has not been determined whether and how this may affect harbour porpoises and seals under water. On the other hand, the harbour porpoise sight above the water surface is very poor, and although seals have sharp eyesight, it is not known to what extent the sight of wind turbines induces their distress and changes in behaviour.

The introduction of hard elements in the form of foundations and/or support structures into the sandy seabed shall induce changes in the environment and may have a positive effect on marine mammals in the long run. The elements can serve as artificial reefs for harbour porpoises and seals or as shelters with lower noise levels compared to areas with heavy vessel traffic [403, 441]. This impact on marine mammals is assessed to be low or negligible.

Leakage of oil derivatives into the environment due to vessel breakdown

Vessel collisions and their breakdowns resulting in a leakage of oil in the project implementation area may negatively affect marine mammals occurring in the neighbouring waters. However, a fuel leak is

highly unlikely. A development of an oil pollution prevention plan and an action plan for various stages of the project implementation is recommended. Taking this into consideration, the significance of this factor for harbour porpoises and seals was assessed to be moderate.

Collisions with vessels

Collisions with ships apply mainly to large cetaceans. However, data suggest that this factor may also be a significant source of mortality among small cetaceans in the areas with their high density and heavy vessel traffic [472]. Fast ferries are of particular concern due to the high speed at which they travel (often >40 knots) and the relatively low noise levels they generate [67]. Collisions with vessels have also been documented for seals, but in low numbers and mostly involving juvenile individuals [145]. In the case of the BC-Wind OWF, collisions with vessels are unlikely, due to a low density of marine mammals in the survey area, as well as due to the lower travelling speeds of vessels taking part in the servicing and maintaining the OWF. The significance of this factor for harbour porpoises and seals was assessed to be low.

Assessment of the impact significance during the operation phase

The results of the impact assessment of different factors during the OWF operation phase on marine mammals is presented in Table 6.20. The effect of impact on harbour porpoises and seals during the operation phase is generally negligible, low or moderate. In some cases, even positive effects can be indicated, such as e.g. artificial reef effect, which may contribute to the increase in the feeding possibility for all the marine mammals discussed [251].

Table 6.20. Overall effect on marine mammals associated with activities in the operation phase after the application of an NRS [Source: internal materials]

Species	Impact	Impact description	Impact significance
Harbour porpoise <i>Phocoena phocoena</i>	Noise from the operating turbines	Behavioural responses to the noise generated by wind turbines (moving away from the operation site)	Low
	Noise related to operation and maintenance	Behavioural responses to the noise related to operation and maintenance (moving away from the operation site)	Low
	Visual effects	Behavioural changes caused by the obstacles created (moving away from the operation site)	Low
	Reef effect	Increase in the feeding possibilities due to the increase in the fish abundance	Low
	Vessel collisions and breakdown	Pollution caused by the breakdown or collision of vessels used during the operation phase (e.g. fuel leak)	Moderate
	Collisions with vessels	Physical injuries caused by the collision of marine mammals with vessels	Low
Grey seal <i>Halichoerus grypus</i>	Noise from the operating turbines	Behavioural responses to the noise generated by wind turbines (moving away from the operation site)	Low
	Noise related to operation and maintenance	Behavioural responses to the noise related to operation and maintenance (moving away from the operation site)	Low
	Visual effects	Behavioural changes caused by the obstacles created (moving away from the operation site)	Low
	Reef effect	Increase in the feeding possibilities due to the increase in the fish abundance	Low

Species	Impact	Impact description	Impact significance
	Vessel collisions and breakdown	Pollution caused by the breakdown or collision of vessels used during the operation phase (e.g. fuel leak)	Moderate
	Collisions with vessels	Physical injuries caused by the collision of marine mammals with vessels	Low
Harbour seal <i>Phoca vitulina</i>	Noise from the operating turbines	Behavioural responses to the noise generated by wind turbines (moving away from the operation site)	Low
	Noise related to operation and maintenance	Behavioural responses to the noise related to operation and maintenance (moving away from the operation site)	Low
	Visual effects	Behavioural changes caused by the obstacles created (moving away from the operation site)	Negligible
	Reef effect	Increase in the feeding possibilities due to the increase in the fish abundance	Low
	Vessel collisions and breakdown	Pollution caused by the breakdown or collision of vessels used during the operation phase (e.g. fuel leak)	Moderate
	Collisions with vessels	Physical injuries caused by the collision of marine mammals with vessels	Low

6.1.2.6.1.5 Migratory birds

Barrier effect

The presence of OWFs creates a barrier effect influencing the behaviour (movement) of migratory birds. The scale of the impact will depend on the number of wind turbines, their size and distribution within the BC-Wind OWF Area. Birds may be forced to change the flight direction horizontally or vertically, which may slightly extend the journey and increase energy requirements. Research conducted so far on this topic indicate that bypassing even a few OWFs increases slightly both the total length of the migration route and the energy expenditure associated with the migration [91, 123, 313]. These results have been included as a reference for this document, but it should be emphasised that the surveys presented in the literature concern other marine areas. Masden *et al.* [270] present the results for the Nysted OWF in the Baltic Sea (165 MW). In a report by Jensen *et al.* [196] the situation of the Horns Rev 3 OWF is presented (400 MW, Horns Rev 3, North Sea). In the case of the Horns Rev 3 OWF, which borders two other OWFs – Horns Rev 1 OWF (160 MW) and Horns Rev 2 OWF (209 MW), it was considered that cumulative impacts would not occur.

The forced change of the route in order to avoid the BC-Wind OWF extends it by an average of 12.4 km, which is an extension of the migration route by an average of 0.5%, and in the case of cranes by 1.0%. The extension of the route by 12.4 km due to the OWF barrier effect will increase the energy expenditure to cover the route by a negligible amount [285, 333]. Additionally, in the case of passerine birds travelling mainly at night and at high altitudes (above the rotor range), the barrier effect will not occur as the birds will fly over the OWF. Therefore, the significance of the barrier effect impact on all the bird groups and species included in the analysis was considered to be negligible.

Risk of collision

The impact in the form of the risk of collision, i.e. bird mortality resulting from collisions with OWF elements, has been presented as the total number of collisions of a given species during the spring and autumn migration periods. The risk of a collision depends on the OWF parameters, such as the number

of wind turbines, rotor diameter, the size of the clearance between the lower range of the rotor and the water surface, on biological and species parameters such as body size, flight speed, flight altitude, collision avoidance rate, as well as on the weather parameters. In the case of reduced visibility (low clouds, night, dense fog), birds are able to spot an OWF from a considerably shorter distance, which results in a higher risk of collision. During analyses both the Applicant Proposed Variant (APV) and the Rational Alternative Variant (RAV) were tested including the different ranges of the clearance height between the lower range of the rotor and the water surface. Among all of the species included in this analysis, the significance of impact resulting from collisions was assessed to be low at most for the long-tailed duck, the common scoter, and the velvet scoter. For these species, the risk of collision did not exceed single individuals. In the case of geese, the risk of collision in the strictest scenario with a collision avoidance rate of 99.0% concerned up to 9 individuals, but due to the very large populations of species included in this category (estimated at more than 3.5 million individuals), the significance of the impact was assessed to be irrelevant. For the remaining species, the significance of the risk of collision was assessed to be negligible [Table 6.21].

Table 6.21. Summary of the BC-Wind OWF impacts affecting the migratory birds during the operation phase. The impact of the barrier effect and the collision risk were assessed for both variants at the same level [Source: internal materials]

Species/group of species	Receptor value/significance	Impact	Impact reversibility	Size of impact	Impact significance
Long-tailed duck <i>Clangula hyemalis</i>	High	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Low
Common scoter <i>Melanitta nigra</i>	High	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Low
Velvet scoter <i>Melanitta fusca</i>	High	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Low
Ducks (Eurasian wigeon, etc.) <i>Anatini</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Greater scaup <i>Aythya marila</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Geese <i>Anseridae</i>	Moderate	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Moderate	Negligible
Swans <i>Cygnidae</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Divers <i>Gaviidae</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Auks <i>Alcidae</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Great black cormorant <i>Phalacrocorax carbo</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Little gull <i>Hydrocoloeus minutus</i>	High	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
	Low	Barrier effect	Reversible	Irrelevant	Negligible

Species/group of species	Receptor value/significance	Impact	Impact reversibility	Size of impact	Impact significance
Black-headed gull <i>Larus ridibundus</i>		Risk of collision	Irreversible	Irrelevant	Negligible
Lesser black-backed gull <i>Larus fuscus</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
European herring gull <i>Larus argentatus</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Common gull <i>Larus canus</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Terns <i>Sternidae</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Charadriiformes <i>Charadriiformes</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Common crane <i>Grus grus</i>	High	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Moderate	Negligible
Passerines Passeriformes	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Barrier effect	Reversible	Irrelevant	Negligible

6.1.2.6.1.6 Seabirds

Identification of the main factors affecting seabirds during the operation phase

The potential impact of wind turbines located in the open sea areas on the seabirds involves an increased mortality due to collisions with wind turbines as well as the changes in the distribution and behaviour of birds. The highest mortality is recorded in the case of wind farms located within feeding grounds and along regular flight routes.

To identify the significance of the impact, its scale was assessed to be high for the long-tailed duck, the velvet scoter and the common scoter, as moderate for the razorbill and the common guillemot and as irrelevant for the European herring gull.

The factors identified and the assessment of their impact on the marine avifauna in the operation phase is presented below.

Vessel traffic

The presence of vessels and fixed structures protruding from the water shall lead to a greater presence of gulls and cormorants, which use these elements as resting places and search for food near the vessels. Three species of large gulls, including the most abundant there the European herring gull, gather in the open sea around the fishing boats. If during the operation of the OWF, the commercial fishing becomes restricted in this sea area, the gulls shall move (at least partially) to other fishing locations.

The BC-Wind OWF operation shall involve the traffic of various types of vessels supporting the OWF operation.

The traffic of vessels in the operation phase shall cause direct, negative impact on seabirds, of local range, long-term, reversible, repeatable during the operation period, and of species-dependent intensity.

The sensitivity to the impact was assessed to be low for the European herring gull and high for the other bird species.

The significance of the impact varies for individual species and it is assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot as well as important for the duck species analysed – the long-tailed duck, the velvet scoter and the common scoter.

Disturbance and displacement from habitats

After the erection of the OWF, most bird species shall avoid this area and as a result shall largely lose access to the feeding ground.

The operation of the OWF shall cause the disturbance and displacement of some of the seabirds residing in the sea area occupied by the power stations and the adjacent strip of waters with a width of approx. 2 km 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 turbines. Such a behaviour minimises the risk of collision, especially during the day at good visibility. However, the OWF Area shall become excluded as a feeding ground for a long time for a large part of the individuals, which may have a negative impact on some species.

The most important parameters affecting the level of impact:

- number of power stations;
- density of power stations;
- clearance between the sea surface and the lower level of the rotor blade (the majority of flights takes place at the altitude of 20 m above the water surface);
- rotor diameter;
- distance from the neighbouring OWFs – adjacent OWFs intensify the barrier effect.

Disturbance and displacement from habitats in the operation phase shall result in a direct, negative, and local range impact on the seabirds. For the razorbill, the common guillemot, the European herring gull, the velvet scoter and the common scoter this is a long-term and permanent impact, and for the long-tailed duck it is short-term and temporary.

The sensitivity to the impact was assessed to be low for the European herring gull and high for the other bird species.

The significance of the impact varies for individual species and it is assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot as well as important for the duck species analysed – the long-tailed duck, the velvet scoter and the common scoter.

Barrier creation

The structures of the wind turbines shall occupy part of the OWF sea area, creating a barrier for the seabirds travelling locally between the feeding grounds or resting places and reluctant to fly over obstacles. The scale of the barrier effect shall depend on the number of the wind turbines erected and their size. However, the selection of a particular variant shall not significantly affect the size and

significance of the project impact on the seabirds. A distinct avoidance of the area occupied by the wind turbines by the seabirds and a decrease in their abundance in the area surrounding the turbines is observed, for example, for the long-tailed duck at a radius of up to 2 or even 4 km [61, 327, 253]. Gulls and cormorants are an exception, since they often use the structures protruding above the water as their resting places, and as a result their abundance may even increase.

The barrier effect created by the BC-Wind OWF applies mainly to the migratory birds. However, some of the seabirds migrating across the OWF Area may fly to the nearby Natura 2000 sites – the Słupsk Bank, Przybrzeżne wody Bałtyku and Pobrzeże Słowińskie, where they can have their stopover, wintering or breeding grounds. The creation of a uniform barrier in this area may also impede the movement of these populations between the nearest similar wintering grounds, such as the Słupsk Bank, the Middle Bank and the Hoburgs Bank. Currently, there are no scientific data available on the significance of the links between these areas, but they cannot be excluded.

The new structures present in the OWF operation phase shall be the source of direct, negative impacts on seabirds, characterised by a local range, long-term, reversible, permanent in the operation period, and with a species-dependent intensity.

The operating wind turbines shall create a physical barrier posing a risk of collision, and on the other hand, disturbing the birds and resulting in the loss of feeding grounds. The bird-scaring effect of the OWF minimises the risk of collision. However, the risk of collision applies, to a larger extent, to the migrants flying at night and in the limited visibility conditions than to the birds residing in the project area.

The creation of a barrier in the operation phase shall result in a direct, negative impact on the seabirds, of a local range. For the razorbill, the common guillemot, the European herring gull, the velvet scoter and the common scoter this is a long-term and permanent impact, and for the long-tailed duck it is short-term and temporary.

The sensitivity to the impact was assessed to be low for the European herring gull and high for the other bird species.

The significance of the impact varies for individual species and it is assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot as well as important for the duck species analysed – the long-tailed duck, the velvet scoter and the common scoter.

Collisions with wind turbines

The risk of bird collision with the wind turbines shall increase with the progressing OWF construction, reaching its maximum in the OWF operation phase.

Wind turbines change the way in which birds use the space, which applies also to the sea areas. In the majority of cases, wind turbines scare the birds away and the flying birds avoid the fields with wind turbines at a distance from 100 to even 3000–4000 m [61, 327, 253]. In consequence, the areas directly adjacent to wind turbines are used as the feeding and resting places much less. The area in which the towers of the wind turbines are erected becomes to a large extent unavailable to birds as a feeding ground, and in some cases a distinctly lower density of birds is observed at a distance of up to 2 or even 4 km from a wind turbine [335]. Avoiding the area in which the wind turbines are erected by seabirds and the low altitude of their flight between the power station towers reduces the risk of collision, and as a result the mortality due to collisions with power station structures in sea areas is

low. However, at poor visibility caused by fog or precipitation, the risk of collision increases. The number of collisions with wind turbines visibly increases when they are located in the sea areas attractive to birds, with high bird density, and also when the wind turbines are located along the regular flight routes connected to migration or local passages.

The risk of collision depends also on the bird species. Large species of waterbirds such as swans are at higher risk of collision with wind turbines due to the difficulty with making sudden manoeuvres in the air [58]. The majority of waterbird species travel low above the water surface, and when between wind turbines, lower their flight altitude and maintain equal distances from the obstacles [100, 181, 327]. This means that the risk of collision is affected by the clearance between the lower position of the rotor blade and the sea surface. The smaller the clearance, the higher the risk of bird collision with the operating rotor.

The collisions with wind turbines during the operation phase shall result in a direct, negative, local impact on the seabirds. For the razorbill, the common guillemot, the European herring gull, the velvet scoter and the common scoter this is a long-term and permanent impact, and for the long-tailed duck it is short-term and temporary.

The sensitivity to the impact was assessed to be low for the European herring gull, moderate for the razorbill, the common guillemot, the velvet scoter and the common scoter, and high for the long-tailed duck.

The significance of the impact varies for individual species and it is assessed to be negligible for the European herring gull, low for the razorbill and the common guillemot, moderate for the velvet scoter and the common scoter, and important for the long-tailed duck.

Formation of an artificial reef

Habitat changes caused by the creation of an artificial reef may have a certain positive impact on seabirds feeding on benthos, by expanding the food base. Rich benthic communities shall form on the underwater parts of the construction as well as on the seabed of the area occupied by the OWF, which may translate to the increase in the abundance of fish. However, these resources shall be to a small degree or even not at all exploited by birds. The bird-scaring effect of the structures protruding from the water shall be dominant there. The most important parameters affecting the level of impact are the shape, diameter of the base and the number of foundations or support structures.

The sensitivity to the impact was assessed to be irrelevant for the European herring gull, moderate for the razorbill and the common guillemot, and high for the long-tailed duck, the velvet scoter and the common scoter.

The significance of the impact varies for individual species and it is assessed to be negligible for the European herring gull, low for the razorbill and the common guillemot as well as important for the duck species analysed – the long-tailed duck, the velvet scoter and the common scoter.

Creation of an enclosed sea area

The OWF Area can be an area completely or partially closed to commercial fishing during the operation phase. In the case of such a partial or complete closing of the sea area, it may be expected that in the OWF Area fish shall find very good habitat conditions (no fishing, rich benthic communities). However, the birds shall use the food base formed to a small degree, because the bird-scaring effect of the structures protruding high from the water shall be dominant.

The sensitivity to the impact was assessed to be irrelevant for the European herring gull, moderate for the long-tailed duck, the velvet scoter and the common scoter, and high for the razorbill and the common guillemot.

The significance of the impact varies for individual species and is assessed to be negligible for the European herring gull and moderate for the remaining species.

Table 6.22 presents the compilation of individual impacts of the BC-Wind OWF on the seabirds during the operation phase.

Table 6.22. Significance of the project impact on seabirds during the operation phase [Source: internal materials]

Species	Impact	Impact description	Impact significance
European herring gull <i>Larus argentatus</i>	Creation of an enclosed sea area	The OWF Area may be partially closed for fishing	Negligible
	Traffic of vessels and helicopters	Scaring caused by the traffic of vessels, helicopters	Negligible
	Formation of an artificial reef	Formation of a new hard substratum for macrozoobenthos	Negligible
	Disturbance and displacement from habitats	Caused by the operation of wind turbines	Negligible
	Barrier creation	Depending on the number of wind turbines, emission of light and noise	Negligible
	Collisions with wind turbines	Depending on the bird movement, densities, flight altitude, parameters of the wind turbines	Negligible
Razorbill <i>Alca torda</i> , Common guillemot <i>Uria aalge</i>	Creation of an enclosed sea area	The OWF Area may be partially closed for fishing	Moderate
	Traffic of vessels and helicopters	Scaring caused by the traffic of vessels, helicopters	Moderate
	Formation of an artificial reef	Formation of a new hard substratum for macrozoobenthos	Low
	Disturbance and displacement from habitats	Caused by the operation of wind turbines	Moderate
	Barrier creation	Depending on the number of wind turbines, emission of light and noise	Moderate
	Collisions with wind turbines	Depending on the bird movement, densities, flight altitude, parameters of the wind turbines	Low
Velvet scoter <i>Melanitta fusca</i>	Creation of an enclosed sea area	The OWF Area may be partially closed for fishing	Moderate
	Traffic of vessels and helicopters	Scaring caused by the traffic of vessels, helicopters	Important
	Formation of an artificial reef	Formation of a new hard substratum for macrozoobenthos	Important
	Disturbance and displacement from habitats	Caused by the operation of wind turbines	Important
	Barrier creation	Depending on the number of wind turbines, emission of light and noise	Important

Species	Impact	Impact description	Impact significance
	Collisions with wind turbines	Depending on the bird movement, densities, flight altitude, parameters of the wind turbines	Moderate
Long-tailed duck <i>Clangula hyemalis</i>	Creation of an enclosed sea area	The OWF Area may be partially closed for fishing	Moderate
	Traffic of vessels and helicopters	Scaring caused by the traffic of vessels, helicopters	Important
	Formation of an artificial reef	Formation of a new hard substratum for macrozoobenthos	Important
	Disturbance and displacement from habitats	Caused by the operation of wind turbines	Important
	Barrier creation	Depending on the number of wind turbines, emission of light and noise	Important
	Collisions with wind turbines	Depending on the bird movement, densities, flight altitude, parameters of the wind turbines	Important
Common scoter <i>Melanitta nigra</i>	Creation of an enclosed sea area	The OWF Area may be partially closed for fishing	Moderate
	Traffic of vessels and helicopters	Scaring caused by the traffic of vessels, helicopters	Important
	Formation of an artificial reef	Formation of a new hard substratum for macrozoobenthos	Important
	Disturbance and displacement from habitats	Caused by the operation of wind turbines	Important
	Barrier creation	Depending on the number of wind turbines, emission of light and noise	Important
	Collisions with wind turbines	Depending on the bird movement, densities, flight altitude, parameters of the wind turbines	Moderate

6.1.2.6.1.7 Bats

The potential impact of the BC-Wind OWF on migratory bats during the operation phase will be caused by:

- the collisions with wind turbines;
- the emission of noise and light;
- the barrier effect;
- the habitat change.

Collisions with wind turbines

Studies show that in the late summer, wind turbines in the Baltic Sea at a distance of up to 10 km from the Swedish coast attract bats [3]. 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 [395, 404].

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 have shown that most of the bats killed in the area of onshore wind turbines are likely to be lost due to internal injuries caused by barotrauma [11, 147].

Migratory bats fly over the sea at low altitudes. However, if they come across a wind turbine, they can change the flight height from the water surface to the top of the wind turbine within only a few seconds [3]. Moreover, bats may be enticed by the concentration of a food supply accumulating around wind turbines in favourable weather conditions, such as low wind speeds, high temperatures and the lack of precipitation [344]. Wind turbine towers absorb heat during the day, thus attracting insects the concentration of which constitute an attractive feeding ground for bats [397]. Insects may gather at the top of the wind turbine as a result of the phenomenon known as *hill-topping* [397]. 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 $10 \text{ m}\cdot\text{s}^{-1}$, while the highest activity of bats being recorded at the wind speed below $5 \text{ m}\cdot\text{s}^{-1}$ [2]. 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 there will be days in which bats will gather for feeding while the OWPS is operating.

The effects of collisions with masts and rotors, as well as the risk of barotrauma, are assessed to be negative, direct, local and permanent, of moderate intensity. Therefore, average structural and functional changes are to be expected. However, as the surveys conducted in the BC-Wind OWF Area indicated mainly very low or low bat activity, the impact of the risk of collision and barotrauma is assessed to be low.

Emission of noise and light

Ultrasonic noise generated by the nacelle may attract bats, but this hypothesis has not been confirmed and seems unlikely [397]. The same applies, according to Rydell *et al.* [397], to the assumption that the red warning lights of wind turbines entice bats. However, it has been proven that red light is more attractive to bats than the white one [481]. 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 OWF may exert a barrier effect on migrating bats. The noise emitted by operating wind turbines 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 [124].

Habitat change

Structural elements can be used as places of rest along the migration route or can constitute attractive hiding places due to the aforementioned insect concentrations [3, 397].

Surveys conducted in the autumn and spring migration periods indicated a possibility of bats migrating in the OWF Area. However, the migration intensity was low due to the low activity of bats.

The BC-Wind OWF impacts presented for the operation phase will be negative, direct, and long-term.

Sensitivity to the impact was assessed to be low, whereas the significance of the BC-Wind OWF impact during the operation phase was assessed to be low 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

Due to the location of the BC-Wind OWF at a significant distance from the Słowiński National Park, similarly to the construction phase, during the operation phase, there will be no significant impacts on this area, including on any element for which it has been established, such as biodiversity, resources, objects and elements of inanimate nature and the landscape of the Park.

In the appendix to the Regulation of the Minister of the Environment of 16 February 2017 on the protection tasks for the Słowiński National Park (Official Journal of the Ministry of the Environment 2017, item 10, as amended), in which the existing and potential internal and external hazards, as well as the methods of elimination or reduction of such hazards and their effects have been identified, as one of the existing external hazards, a hazard has been indicated resulting from the expansion of the areas intended for the development of wind farms in the municipalities neighbouring the park. In terms of potential external hazards, it has been indicated that only the erection of wind farms in the park buffer zone constitutes a potential external hazard, and thus, it should be concluded that the BC-Wind OWF shall not pose a hazard to the Słowiński National Park.

6.1.2.6.2.2 Impact on the Natura 2000 protected areas

The 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 the wildlife corridors in the sea areas is described in Subsection 6.1.1.4.3.

Due to the same reasons concerning the knowledge about wildlife corridors in maritime areas and the spatial scale of the BC-Wind in relation to the size of the Baltic Sea, including the constant impact of space development, it was assessed that the impact of the separately analysed BC-Wind OWF on migration routes of migratory species during the operation phase, similarly as during the construction phase, will be negligible.

6.1.2.6.4 Impact on biodiversity

Phytobenthos and macrozoobenthos

During the operation phase of the BC-WIND OWF, 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 facilitate the spread of foreign species, which lowers the ecological quality of this micro-habitat.

Ichthyofauna

The artificial reef effect present during the operation 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 surveys on the long-term impact of the Horns Rev 1 OWF on the abundance and taxonomic composition of fish have shown 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 [425].

Possible reduction or cessation of fishing in the OWF Area due to legal regulations or navigation problems may have a positive impact on diversity. The impact of the “artificial reef” effect will probably be only local and will not increase biodiversity in a larger area.

Marine mammals

The BC-Wind OWF operation phase shall have no negative impact on the marine mammals biodiversity in the survey area and the neighbouring waters. Moreover, the reef effect may contribute to the increase in the abundance of fish inhabiting the survey area, and in consequence in the abundance of marine mammals as well.

Seabirds

The analysis of the possible impacts resulting from the OWF operation indicates that their effects in terms of the changes in biodiversity of seabirds shall be of local character.

This shall involve a potentially increased mortality as a result of collisions with wind turbines or vessels. The highest mortality is recorded in the case of the OWFs located within feeding grounds and along regular flight routes. The risk of collision depends also on the bird species. Large species of waterbirds such as swans are at higher risk of collision with wind turbines due to the difficulty in making sudden manoeuvres in the air [58].

Moreover, a different hazard identified for the biodiversity is the disturbance and displacement of some of the seabirds residing in the sea area occupied by a power station and the adjacent strip of water with a width of approx. 2 km or even 4 km. The degree and area of bird displacement from this sea area and its surroundings shall depend on the bird species. In the operation phase, this shall cause indirect, negative, local impact on seabirds; this impact is dependent on the number of wind turbines, and electrical substations exploited as well as the number of vessels used for their servicing. Light and noise emission is another bird-scaring factor. During the first season of operation, 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 after the completion of the construction of the entire project, the scale of the BC-Wind OWF impact on the seabirds residing in this area will stabilise. However, habituation shall not make the birds return to the area occupied by the OWF.

The barrier created by the BC-Wind OWF applies mainly to the migratory birds. However, some of the seabirds migrating across the OWF Area may fly to the nearby Natura 2000 sites, where they can have their stopover, wintering or breeding grounds. The creation of a uniform barrier in this area may also impede the movement of these populations between the nearest similar wintering grounds, such as the Słupsk Bank, the Middle Bank and Hoburgs Bank. Currently, there are no scientific data available

on the significance of the links between these areas, however, in line with the precautionary principle, they cannot be excluded. The scale of the barrier effect shall depend on the number of the wind turbines erected and their size. A distinct avoidance by the seabirds of the area occupied by the wind turbines and a decrease in the seabird abundance in the area surrounding the turbines is observed, for example, for the long-tailed duck at a radius of up to 2 or even 4 km [61, 327, 253]. Gulls and cormorants are an exception, since they often use the structures protruding above the water as their resting places, thus, their abundance may even increase. This impact can be important for the seabird species sensitive to it, which may negatively affect biodiversity in the OWF Area.

To sum up, the impact of the OWF on the seabird biodiversity coincides largely with the effect of their habitats loss.

6.1.2.7 Impact on cultural values, 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 BC-Wind 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 designated 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 use and development of the sea area and tangible property

During its operation, the BC-Wind 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 turbines under the conditions agreed upon with investors. Decisions on permits for vessels other than the vessels supporting the OWF in the BC-Wind OWF Area will be made by the relevant maritime administration authorities.

The exclusion of the BC-Wind 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 BC-Wind OWF in relation to the shortest routes to fisheries in the vicinity 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 OWFs. In no manner will the exclusion from free passage through the BC-Wind OWF Area affect fishermen from other ports fishing in the Słupsk Furrow region. This is described in detail in the subsection 7.4.3.4.

As a result of a maritime area being occupied by the BC-Wind OWF, this area may be excluded from the possibility of fishing. The BC-Wind OWF Area is located within two statistical rectangles. 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 operation phase the following potential impacts of the project on the landscape, including the cultural landscape, were identified:

- operating offshore structures such as wind turbines, collection stations, export station;
- vessel traffic required for the OWF operation.

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 operation 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 turbines and facilities;
- the traffic of vessels related to the operation 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 operation 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 operation 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 turbines will be visible from the coastline or not. Figure 6.2 presents the number of hours per year for a given visibility (how often the visibility is greater than a specific value) based on the 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 Łeba there will be no situation in which the OWF will be visible from this place. In the case of Lubiatowo and Dębki, single wind turbines may be visible even for approx. 6000 hours per year, but 100% of wind turbines installed in the BC-Wind OWF may be visible up to 1000 hours per year. In the case of Jastrzębia Góra, single wind turbines may be visible for more than 4000 hours per year, and all wind turbines installed in the BC-Wind OWF may be visible for up to a few hundred hours per year.

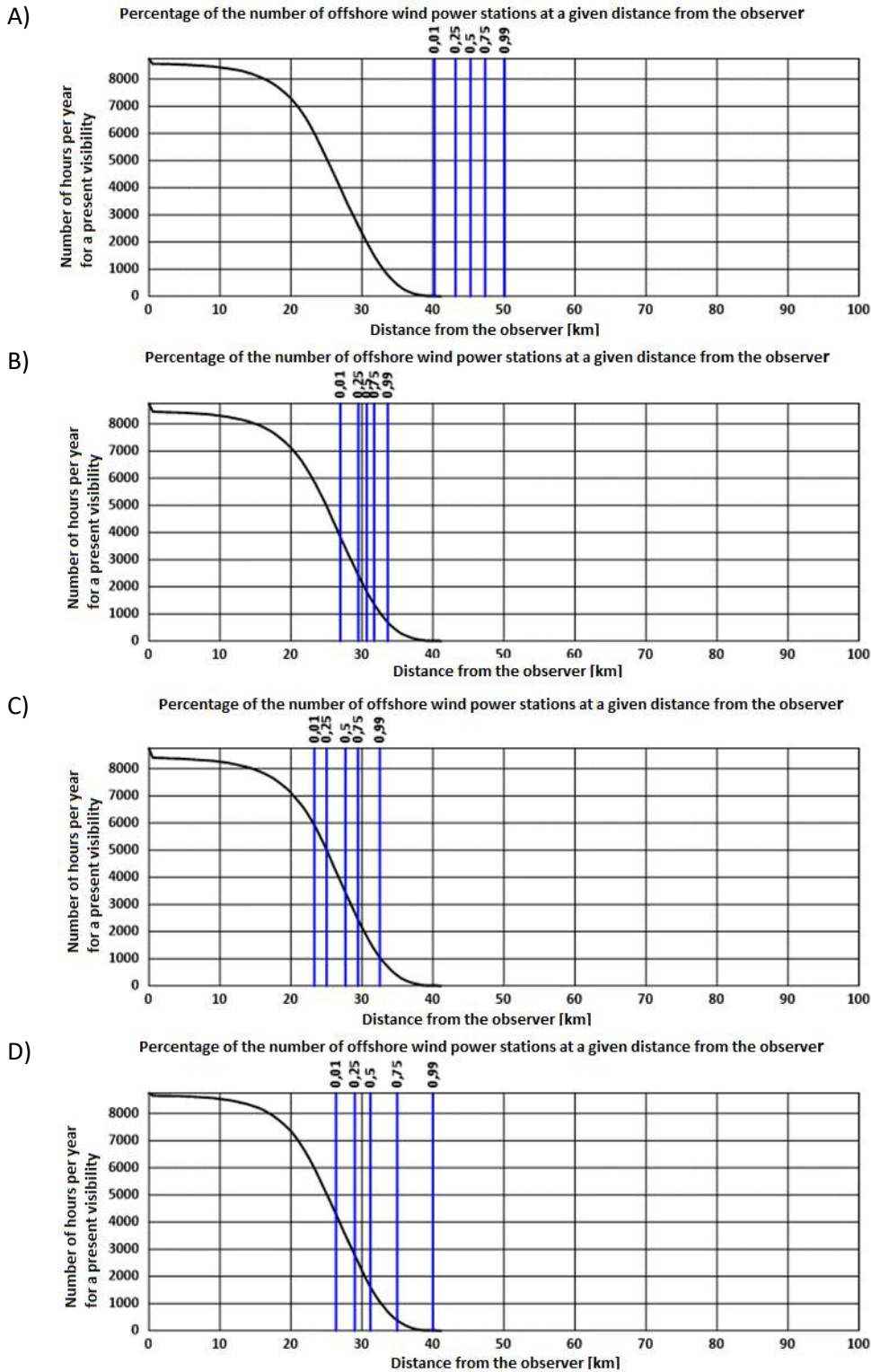


Figure 6.2. Number of hours per year for the preset visibility (distance from the observer) together with the distances of offshore wind turbines marked in the Applicant Proposed Variant (total number of offshore wind turbines assumed and other large-size structures – 41). Graph A – Łeba, B – Lubiatowo, C – Dębki, D – Jastrzębia Góra [Source: internal materials]

Additionally, the constraint associated with the visibility of wind turbines from land is the Earth's curvature and the associated height restriction of the objects that can be seen from a great distance. In practical terms, this limitation manifests itself by the phenomenon that the further the OWPS are

located from the observer, the fewer of them can be seen. However, the planned structures are large enough for the number of visible wind turbines/structures to be influenced by atmospheric visibility and not by the Earth's curvature. Photographs 6.1 and 6.2 (Photo 6.1, Photo 6.2) show the visualisation of the view on the BC-Wind OWF from Białogóra and Dębki. The visualisation on a larger scale is presented in Appendix 5 to the EIA Report.



Photo 6.1. Visualisation of the view on the BC-Wind OWF Area from Białogóra (summer season) [Source: data C-Wind Sp. z o.o.]



Photo 6.2. Visualisation of the view on the BC-Wind OWF Area from Dębki (autumn season) [Source: data from C-Wind Sp. z o.o.]

In the Applicant Proposed Variant, the maximum height of an OWPS may be 330 m, and the maximum rotor diameter may be 280 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 approximately 22.6 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. Within the area of the OWF's potential impact on the landscape there is a land area in the section from Łeba 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: Rowy, Czołpino lighthouse, dunes in the Słowiński National Park, Łeba, Stilo lighthouse and 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 operation phase of the BC-Wind OWF, which will be located at a distance of approx. 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 to be 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 the impact will have a large spatial extent, which will decrease with the increasing distance from the OWF, 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 BC-Wind OWF is included in Appendix 5 to the EIA Report.

Wizualizację widoku na MFW BC-Wind zamieszczono w Załączniku 5 do Raportu OŚ.

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 operation, 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 BC-Wind OWF operation, the number of passages of vessels servicing the OWF may amount to several dozen per year. These vessels will move mainly between the ports of the central coast and the OWF Area. The number of possible passages along the route the Gulf of Gdańsk – the BC-Wind OWF – the Gulf of Gdańsk (or along other routes depending on the service port) during the operation phase will be much smaller, about one hundred per year.

Regular services provided to the OWF during the operation 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 BC-Wind 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 BC-Wind 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 operation of the BC-Wind 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. 22.6 and more kilometres), the noise from wind turbines 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 BC-Wind 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 turbines (parts of the tower

and the rotor). The number of visible wind turbines 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 BC-Wind 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 operation 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 BC-Wind OWF from permanent places of residence and work of people is large, the impact of the BC-Wind OWF was considered negligible in this case.

6.1.3 Overlapping of construction and operation phases

Table 6.23 presents the information compiled on the significance of impacts in the construction and operation phases, as well as on the significance of such impacts in the case of simultaneously conducted construction and operation phases. It should be emphasised that although the overlapping of the construction and operation phases was assessed to be having the highest significance among all the impacts assessed for the construction and operation phases, the intensity of impacts shall often not reach their maximum values, understood as the sum of the impact intensities from the construction and operation phases. For example, during the overlapping of the construction and operation phases, the vessel traffic shall be at a constant level due to construction works and shall gradually increase due to maintenance works, in proportion to the percentage of wind power turbines commissioned. When most of the power turbines are installed, it may turn out that the intensity of the vessel traffic will be at the level of traffic during the construction phase with the additional traffic of the service vessels during the operation phase. However, for the majority of the duration of the overlapping construction and operation phases, the intensity will not be close to the sum of the intensities of the construction and operation phases.

The majority of impacts in both phases is local; therefore, no cumulation of the impacts of the actions carried out for the construction and operation processes shall be possible. This results from the fact that until the construction of a particular wind turbine is completed, no operation of this wind turbine is conducted. Therefore, it was assumed that the impact significance during the overlapping of the

construction and operation phases has a higher value than the one for the impact significance during the construction and operation phases.

For the cases in which the impact did not occur in any of the phases, the significance of impact was adopted for the phase in which the impact occurred.

Table 6.23. Assessment of the impact significance in the construction and operation phases, as well as in the case of the construction and operation phases overlapping [Source: internal materials]

Receptor	Significance of the BC-WIND OWF impact		
	Construction phase	Operation phase	Overlapping of construction and operation phases
Seabed	Negligible	Negligible	Negligible
Wave motion and sea currents	None	Negligible	Negligible
Sea water	Negligible	Negligible	Negligible
Seabed sediments	Negligible	Negligible	Negligible
Climate	Negligible	Negligible	Negligible
Systems using EMF	None	Negligible	Negligible
Phytobenthos	None	Negligible	Negligible
Macrozoobenthos	Low	Moderate	Moderate
Ichthyofauna	Negligible	Negligible	Negligible
Marine mammals	Moderate	Moderate	Moderate
Migratory birds	Negligible	Negligible	Negligible
Seabirds	Important	Important	Important
Bats	Negligible	Low	Negligible
Wildlife corridors	Negligible	Negligible	Negligible
Biodiversity	Low	Important	Important
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 the 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 and/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, 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 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 BC-Wind 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 BC-Wind infrastructure and changes in the seabed relief resulting from the removal of the BC-Wind 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 BC-Wind), cavities in the seabed made at places of anchoring of the vessels decommissioning the BC-Wind 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 to be negligible.

6.1.4.2 Impact on the seawater and seabed sediment 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 OWFs in the continental shelf areas and the Exclusive Economic Zones. 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 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;
- the decommissioning involves an unacceptable risk of pollution to 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 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.

During the BC-Wind OWF decommissioning, identical impacts are expected to occur on the receptors discussed (water and seabed sediments) 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 and/or support structures and cables from the seabed, the impact on the quality of water and sediments will be similar to that from the stage of embedding the foundation and/or support structures in the seabed during the construction phase. If foundations and/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 the 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.

The 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, and of low intensity.

The significance of this impact during the decommissioning phase in the APV was assessed to be negligible for the quality of sea waters and seabed sediments.

The 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 at the decommissioning phase in the APV due to random and sporadic nature of breakdowns and collisions was assessed to be low or moderate for the quality of sea waters and seabed sediments.

Contamination of water and seabed sediments with anti-fouling agents

The 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 to be 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

The 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 to be 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 to be negligible for the quality of sea waters and low for seabed sediments.

6.1.4.3 Impact on the climate, including greenhouse gas emissions and impacts relevant for adaptation to climate change, impact on atmospheric air (air quality)

Due to the significant distance of the BC-Wind 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 turbines.

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 BC-Wind 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 offshore area

6.1.4.5.1.1 Phytobenthos

The decommissioning phase will involve the removal of the wind turbine supporting structures and its associated infrastructure from the offshore area. In such case, also the macroalgae growing on the structures in the euphotic zone will be removed. Thus, reinstatement of the original conditions from before the project execution will occur. 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 OWF operation 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 BC-Wind OWF, the following impacts on macrozoobenthos are expected to occur:

- disturbance of the seabed sediment structure;
- increased concentration of suspended solids in the water;
- sedimentation of suspended solids on the seabed;
- redistribution of pollutants from sediment into water;
- removal of artificial substrates of underwater wind turbine systems from the marine environment – decommissioning of the “artificial reef”.

The most important technical parameters of the OWF which are important from the point of view of the assessment of the project impact on macrozoobenthos during the closure and decommissioning phase are:

- the OWF Development Area;
- wind turbine foundations – type and number of decommissioned foundations.

The assessment of the impact of wind turbines in the BC-Wind OWF Area (1 NM) during the closure and decommissioning phase was carried out separately for:

- the soft bottom macrozoobenthos;
- the hard bottom macrozoobenthos.

A separate assessment of the project impact on macrozoobenthos is the result of these two benthic fauna communities (from the soft and hard bottoms) differing in the taxonomic composition, abundance and biomass of their taxa. Consequently, they differ in significance and sensitivity regarding the various types of impact. The significance and sensitivity of the group of organisms assessed (the soft and hard bottom macrozoobenthos) together with the evaluation of the impact scale (nature of interactions, type of interactions, spatial extent, time scope) influence the assessment of a given impact significance.

The significance of the macrozoobenthos complex from the soft bottom is low while the significance of the macrozoobenthos complex from the hard bottom is high [Subsection 6.1.1.4.1.2]. The definition of macrozoobenthos sensitivity is provided in Table 6.4.

After an average period of 20–25 years of the OWF operation, it will undergo the closure and decommissioning process [236]. Because the decommissioning process of the OWFs built in Europe has begun only recently, the experience in carrying out this process from the technical, legal, logistic, economic let alone environmental impact perspective is very limited. So far, between 2015 and 2019 only 5 minor OWFs comprising several large-diameter piles (2 OWFs in Sweden in the Baltic Sea; 1 OWF in Denmark, 1 OWF in Holland and 1 OWF in the UK in the North Sea) and single wind turbines in shallow waters in Portugal and Germany have been disassembled. In Europe, there are no legal regulations and guidelines that would be adjusted to local environmental conditions and based on the experience being gained from the decommissioning of the oil and gas platforms and expert knowledge [28, 416, 130, 236, 452, 453, 358]. The manner of decommissioning of the underwater OWF structures (full or partial removal of foundations, removal of cables or leaving the cables buried in the seabed) is of crucial importance in the environmental impact and its biotic elements, among others, the benthic fauna.

During the closure and decommissioning of the BC-Wind OWF, it is expected that the occurring impacts on the macrozoobenthos will be similar to those from the construction phase [Subsection 6.1.1.4.1.2]. This assessment assumes that most OWF facilities will be removed from the seabed in their entirety. However, the scale of impact of individual components will very much depend on the technical concept of this project and the type of foundations applied which is, currently, difficult to predict. Therefore, the impact evaluation at this stage stipulates the worst-case scenarios for the macrozoobenthos.

The structure of seabed sediments may be disturbed as a result of the removal of foundations and/or support structures as well as cables connecting the wind turbines from the seabed and during operation of jack-up type vessels. The removal methods depend not only on the local environmental conditions, but also on the types of foundations and ships and tools available [303] which will have a decisive influence on the scale of the impact discussed. This will result in physical destruction (e.g. crushing, scraping off, elimination from the natural environment) and increased mortality of the benthic fauna which will have inhabited the seabed around the foundations and/or supporting structures and along the cable routes during the OWF operation phase [221, 516, 35].

Due to the moderate sensitivity of both the soft and hard bottom macrozoobenthos complexes 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 slower for bivalves. At present, the technical concept for removing the underwater OWF structures is unknown; therefore, the scale of this impact may be smaller than the similar impact from the construction phase. With such assumption, both for the moderate and low scale of impact, the significance of the disturbance of the seabed sediment structure in the OWF decommissioning phase will be low [Table 6.24, Table 6.25].

Increased concentration of suspended solids in water will occur as a result of disturbance of the seabed sediment structure during works related to disassembly of the foundations and/or supporting structures and cables. These works will cause the sediments to rise from the seabed and disperse in the water [249, 516]. One should expect that the disassembly works are carried out in stages and may be of lesser intensity and range than during the construction phase. The dominant negative effect of

this impact is clogging of the filtering systems of the macrozoobenthos representatives feeding in this way [297, 292].

The sensitivity of the soft bottom macrozoobenthos inhabiting the BC-Wind OWF Area to this impact is irrelevant and low for the hard bottom macrozoobenthos complex comprising the aggregations of the *Mytilus trossulus* mussel.

It follows from the conducted model analyses of suspended solid propagation within the BC-Wind OWF Area that the higher suspended solids concentrations (from 30 to more than 100 mg·dm⁻³) have a local range in relation to the location of the dredging works conducted and their impact range does not exceed the distance of 1000 m (Appendix 2 to the EIA Report).

Taking into account the sensitivity of individual macrozoobenthos complexes, i.e. irrelevant for the soft bottom macrozoobenthos and low for the hard bottom macrozoobenthos and the scale of the impact described estimated as irrelevant for the soft bottom macrozoobenthos and low for the hard bottom macrozoobenthos, the significance of the increased suspended solids concentration in the BC-Wind OWF Area was evaluated as negligible for the macrozoobenthos [Table 6.24, Table 6.25].

Sedimentation of suspended solids on the seabed is an impact of negative character, as it leads to covering of macroinvertebrates with an additional layer of sediment that restricts the access of benthic organisms to oxygen [174, 33]. Especially sensitive to this impact is the epifauna, i.e. the macrozoobenthos fraction living on the sediment surface, as compared to infauna, i.e. animals living within the sediments and having better movement abilities [292, 174].

The results of the model calculations of suspended solids dispersion in the BC-Wind OWF Area included in Appendix 2 to the EIA Report indicate that the average thickness of sediments in the entire area of the BC-Wind OWF deposited as a result of the works conducted may not exceed 0.8 mm and due to the local nature of this impact, the entire benthic complex will be subject only to short-term exposure to unfavourable conditions.

It was determined that the sensitivity of both macrozoobenthos complexes in the BC-Wind OWF Area to the sedimentation of suspended solids on the seabed is low. Given the small scale of this impact, it was concluded that the significance of the impact of this factor on the benthic fauna will be negligible [Table 6.24, Table 6.25].

Redistribution of pollutants from sediments into water that will occur during the OWF decommissioning phase and its negative impact on macrozoobenthos will depend on the concentration of heavy metals and persistent organic pollutants identified in the seabed sediments of the BC-Wind OWF Area (1 NM). Toxic compounds, when transferred from sediments to the water, may accumulate in benthic fauna tissues causing its mortality [434, 98, 180].

Taking into account the irrelevant sensitivity of both macrozoobenthos complexes assessed and the scale of the impact assessed to be irrelevant in accordance with the results of geochemical surveys provided in Appendix 1 to the EIA Report (low concentrations of substances that are toxic and harmful to benthic fauna in the survey area), this impact of negligible significance will not cause any significant changes in the physiology of the soft and hard bottom macrozoobenthos inhabiting the OWF Area (1 NM) [Table 6.24, Table 6.25].

Table 6.24. Assessment of the impact of wind turbines on the soft bottom macrozoobenthos in the BC-Wind OWF Area (1 NM) during the shut-down and decommissioning phase [Source: internal materials]

Impact	Characteristic of the soft bottom macrozoobenthos complex		Scale (size) of impact					Impact significance
	Significance	Sensitivity	Character	Type	Spatial range	Time span	Size	
Disturbance of the seabed sediment structure	Low	Moderate	Negative	Direct	Local	Medium-term Permanent	Low/moderate	Low
Increase in the content of suspended solids in the water	Low	Irrelevant	Negative	Direct	Local	Short-term Temporary	Irrelevant	Negligible
Sedimentation of suspended solids on the seabed	Low	Low	Negative	Direct	Local	Short-term Temporary	Low	Negligible
Redistribution of pollutants from the sediment into the water	Low	Irrelevant	Negative	Direct	Local	Short-term	Irrelevant	Negligible

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Table 6.25. Assessment of the impact of wind turbines on the hard bottom macrozoobenthos in the BC-Wind OWF Area (1 NM) during the shut-down and decommissioning phase [Source: internal materials]

Impact	Characteristic of the hard bottom macrozoobenthos complex		Scale (size) of impact					Impact significance
	Significance	Sensitivity	Character	Type	Spatial range	Time span	Size	
Disturbance of the seabed sediment structure	High	Moderate	Negative	Direct	Local	Medium-term Permanent	Low/moderate	Low
Increase in the content of suspended solids in the water	High	Low	Negative	Direct	Local	Short-term Temporary	Low	Negligible
Sedimentation of suspended solids on the seabed	High	Low	Negative	Direct	Local	Short-term Temporary	Low	Negligible
Redistribution of pollutants from the sediment into the water	High	Irrelevant	Negative	Direct	Local	Short-term	Irrelevant	Negligible

Removal of artificial substrates of the underwater structures of wind turbines will result in irreversible, permanent elimination of the periphyton complexes of the “artificial reef” and destruction of benthos around each foundation and yet another restructuring of the qualitative and quantitative structure of the macrozoobenthos complex that inhabited the seabed at this location during the several dozen years of the OWF operation. 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. However, based on the experience gained during the decommissioning of the OWF foundations commenced in the several recent years and, predominantly, during the decommissioning of oil and gas platforms, most researchers clearly state that leaving underwater structures together with the “artificial reef” will benefit the environment more, provided that it had positively affected the local ecosystem. They recommend maintaining the biodiversity in these locations and not depriving oneself of the new resources with a certain ecological value (positive significance of the benthos in the trophic network) or even economic value (fish). However, it should be taken into account that these scenarios refer to a situation from, among others, sea areas with higher salinity than the Baltic Sea and they refer to an “artificial reef” forming on lattice foundations [420, 130, 453]. The monitoring at the OWF operation phase will provide the information whether the “artificial reef” that will be created in the BC-Wind OWF Area will be a phenomenon with a positive impact that will allow to recommend only partial removal of the OWF foundations. Currently, it is known that in connection with the removal of artificial substrates, biodiversity will be reduced and the local reduction in the resources of zoobenthos, which is an additional food supply for fish and seabirds, will occur and this is a negative impact. However, the scale of this phenomenon is moderate, at most, as it will pertain to only 41 foundations stipulated in the APV. On the other hand, the original natural state of the seabed habitats in the OWF Area will be restored, which is a positive impact. The assessment of the effect of “artificial reef” decommissioning in the BC-Wind OWF Area (1 NM) is presented in Table 6.26. Even with a very high sensitivity of the periphytic fauna and flora, this impact was considered moderate.

Table 6.26. Impact assessment consisting in the removal of the “artificial reef” in the BC-Wind OWF Area (1 NM) [Source: internal materials]

Impact	Periphytic fauna and flora characteristics in terms of impact		Scale (size) of impact					Impact significance
	Significance	Sensitivity	Character	Type	Spatial range	Time span	Size	
Decommissioning of “artificial reef” (removal of the artificial substrate of underwater wind turbine installations from the marine environment)	High	Very high	Negative May also be positive	Direct	Local	Long-term	Moderate	Moderate

6.1.4.5.1.3 Ichthyofauna

The currently binding laws (the United Nations Convention on the Law of the Sea – UNCLOS; the guidelines of the International Maritime Organization – IMO) require the environment to be restored to the project pre-construction state. This entails the total dismantling of the infrastructure elements in the waters up to a depth of 75 m. However, more and more often, opinions emerge that it would be a more favourable solution to leave the submerged elements of the artificial reef behind [418].

The assessment of the environmental impact of the work carried out during the decommissioning phase of the project is hindered due to a lack of experience in this area as well as a lack of knowledge about the technologies that will become available in the future. The first demolition of a small Yttre Stengrund OWF located near the Swedish coast in the vicinity of Karlskrona was carried out in 2016 [354]. In accordance with the currently binding laws regarding the restoration of the environment to the pre-project state, in this case the wind turbine masts were totally removed and the concrete foundations were cut off flush with the seabed level.

The recommendations issued by the British authorities for the OWF decommissioning process [99] point to the necessity to update the Environmental Impact Assessment prepared before the start of the project with additional information available at a later stage before the dismantling of the infrastructure.

Emission of noise and vibrations

The effect of the impact shall depend on the size of the structure and the technology of dismantling. The currently available technologies of cutting/fragmentation of structural elements are diamond wire cutting, waterjet cutting and underwater explosions [454]. In the case of the two first technologies, the lack of information on the level of noise generated hinders the assessment of their possible impact. The level of noise generated as a result of a 45 kg explosion may cause minor damages to the hearing organ of fish at a distance of up to 2.2 km from the location of the explosion [302]. The effect of fish avoiding the area of work is probable. It can be assumed that the level of noise impact will be similar to that of the construction phase. However, it seems probable that the time necessary for the liquidation will be shorter than for the project construction.

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 to be very high for cod, sprat, herring and sand goby, and as high for flounder and common seasnail. The significance of the impact is assessed to be 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 an increase in water turbidity will occur. The intensity of this impact will depend, for example, on the extent to which the infrastructure elements will be removed from the environment. In the case a decision is made to leave the connection cables buried in the sediment, the emission of suspended solids and the destruction of the fauna inhabiting the seabed will be significantly reduced. According to Topham and McMillan [454] such a solution may be more beneficial than removing the

cable which involves major disturbances of the seabed morphology and the increase in the suspended solids concentration.

The release of sediment particles to the water depth may take place also during the removal of the sediments around the elements of metal foundations of wind turbines during their preparation for cutting [454].

In the case solutions are applied that cause the suspended solids emission, the level of this impact will be similar to the one assumed for the construction phase.

The impact related to the increase of suspended solids content will be negative, direct, local, and short-term.

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.

In case toxic chemicals are released, an increased mortality of fish, diseases (e.g. skin diseases, liver and gill damage) and spawning disturbances may occur.

The risk of environmental pollution with the substances emitted from the sediments seems relatively small, due to their low concentrations found in the sediments of the Southern Baltic.

According to Topham and McMillan [454] the risk of a spill of operating fluids from the decommissioned wind turbines can be minimised by dismantling the structural elements on land. The risk associated with the emission of toxic substances during the project decommissioning will be similar to the ones occurring during the construction phase.

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 to be 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 decommissioning, a significant part of the artificial reef will be 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. The end of operation and the removal of elements constituting navigational obstacles 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 concept of leaving at least some of the infrastructural elements is popular in the United States, where the “rigs to reef” programme is implemented. It involves leaving the oil exploration infrastructure elements in the environment as a substratum enabling the formation of artificial reefs [200]. In the case of OWFs, this role could be played primarily by the scour protection elements.

The impact related to the change of habitat will be negative, direct, local, long-term and permanent.

The sensitivity to the impact was assessed to be high for all the fish species examined. The significance of the impact is assessed to be negligible for all the fish species analysed.

6.1.4.5.1.4 Marine mammals

It is generally assumed that the OWF decommissioning process shall take place in the opposite direction to the implementation procedure. This means that many activities carried out in the decommissioning phase shall be similar to the ones in the construction phase. However, pile driving as well as the use of explosives shall not take place. The decommissioning process of the large-diameter piles in the BC-Wind OWF Area may involve the operations specified below, which may generate underwater noise:

- mobilisation of a crane vessel, transport pontoon with a tugboat and a work vessel;
- connection of a crane hook to the transition piece of a large-diameter pile foundation;
- cable cutting;
- removal of foundation or support structure soil to the cutting height;
- cutting, cutting out or burning of a large-diameter pile with an appropriate cutting tool at an appropriate height;
- lifting a large-diameter pile;
- placing a large-diameter pile on a pontoon and its fastening or application of a different technology to make the utilised item buoyant and towing it to a disposal site;
- transport to the shore;
- recycling and utilisation of materials.

From the above list, the most likely noise-generating activities to be assessed are cutting and drilling (in the process of soil removal) and vessel traffic (to and from the area during decommissioning works).

It should be underlined that so far there is limited knowledge on the topic of noise generated during cutting. Hinzmann *et al.* [175] measured the emission of the sound of cutting generated during the demolition of a large-diameter pile. The metal tower was removed from the Amrumbank West OWF Area in the North Sea. Waterjet cutting lasted approx. 32 hours. The sound exposure level (SEL) to the cutting noise was 150.6 dB re 1 μ Pa, and the peak level (L_{peak}) was 175.4 dB re 1 μ Pa at a distance of 750 m. The limit values from the BSH standards: SEL = 160 dB re 1 μ Pa and L_{peak} = 190 dB re 1 μ Pa – were not exceeded during the large-diameter pile cutting process. The highest sound levels were between 250 and 1000 Hz. Exceeding 1 kHz, the level of noise decreased systematically. The decommissioning of a large-diameter pile with a remotely-operated cutting tool can be described as a continuous noise of various sound levels, depending on the pressure used. The impact of the cutting noise on the ambient noise shall be local and to a large degree related to low-frequency sounds. In the Baltic Sea, the noise emitted during large-diameter pile cutting shall locally increase the sound field of the ambient noise, which is already dominated by the navigation sounds.

The noise generated during drilling depends to a large extent on the drilling rig used for drilling. Drillships generate the highest noise levels (up to 174–185 dB re 1 μ Pa in the 20–1000 Hz frequency band) [360]. Erbe and McPherson [116] recorded noise levels related to geotechnical drilling equalling 142–145 dB re 1 μ Pa in the 30–2000 Hz frequency band. The noise from drilling rigs anchored in the seabed, such as jack-up type platforms, will probably be low both in terms of the sound source level as well as frequency [116]. Kyhn *et al.* [240] recorded the noise from Stena Forth drillship in Baffin Bay in Greenland. They noted that the broadband noise was 184 dB re 1 μ Pa rms during drilling and 190 dB re 1 μ Pa rms during maintenance. The noise generated by two exemplary drillships is presented in Figure 6.3. The spectral energy of the noise generated by two drillships is mainly below 1 kHz, and the impact on the local ambient noise shall be to a large extent related to low-frequency sound. Kyhn *et*

al. [240] discovered, however, increased noise levels and peaks at frequencies above 10 kHz, but they were highly correlated with the efficiency and usage of the equipment on board [367]. In the Baltic Sea, the noise generated during drilling will increase the local acoustic field, which is already dominated by the noise generated by vessels.

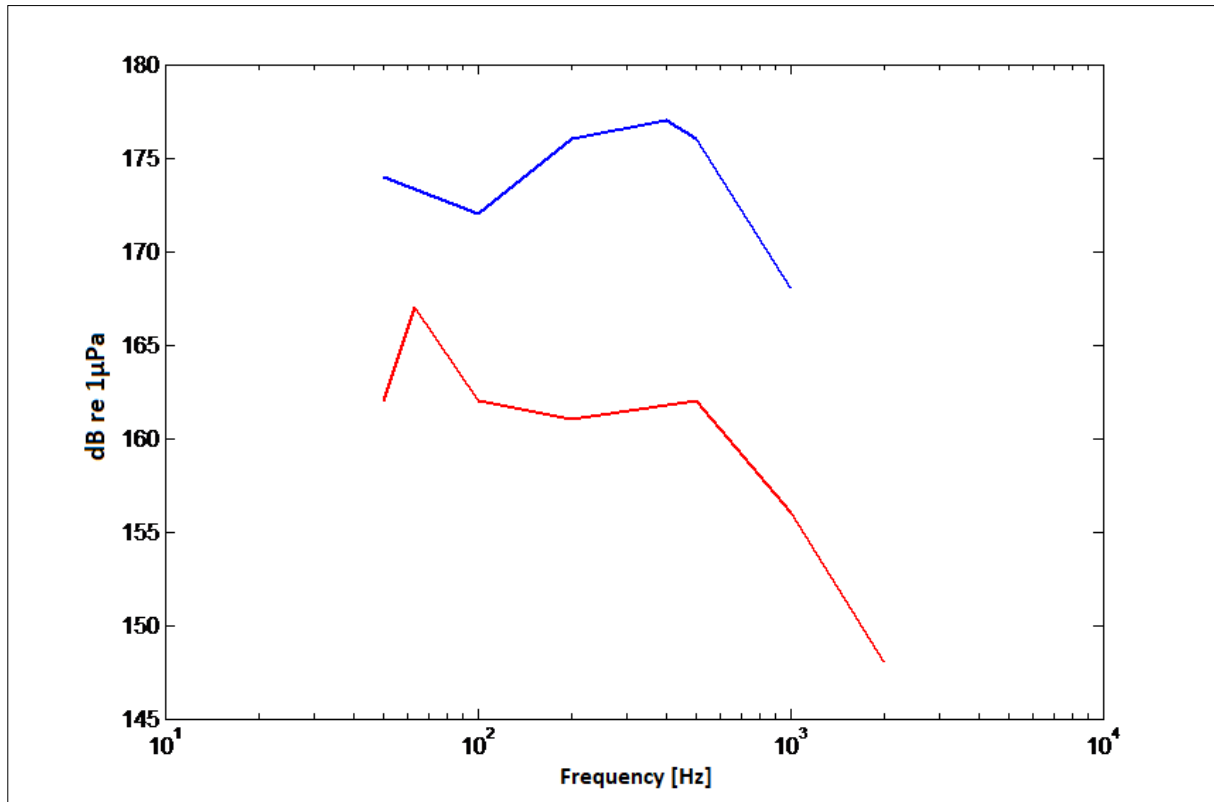


Figure 6.3. Levels of sound from two different drillships in 1/3 octave bands. Modified on the basis of Richardson *et al.* [367] [Source: internal materials]

As was the case during the construction phase, there will be noise from small and medium-sized vessels, which emit mainly sound levels of 160–180 dB re 1 μPa at a distance of 1 m, covering frequencies from <1 kHz to >10 kHz. It is likely that this will lead to the increase in the local acoustic field during the OWF decommissioning phase, covering frequencies that are partially significant for marine mammals.

Assessment of the impact significance during the decommissioning phase

In accordance with the information presented above, it is assumed that the decommissioning of the large-diameter piles will require such operations as cutting, drilling and movement of vessels. However, the impact on the acoustic field will be local and short-term. As a result, the significance of the acoustic field emitted during the OWF decommissioning was assessed to be low or moderate. As has been mentioned earlier, collisions of vessels leading to oil leakages in the project area may negatively affect marine mammals present in the neighbouring waters, however, it is assumed that oil leakages are highly unlikely. The significance of impact in the decommissioning phase was assessed to be moderate at most [Table 6.27].

Table 6.27. Impact on marine mammals related to the activity during the decommissioning phase [Source: internal materials]

Species	Impact	Impact description	Impact significance
Harbour porpoise <i>Phocoena phocoena</i>	Waterjet cutting	Behavioural response to the noise related to the waterjet cutting of a large-diameter pile (moving away from the location of decommissioning operations)	Low
	Noise related to navigation	Behavioural responses to the noise related to navigation (moving away from the location of decommissioning operations)	Low
	Drilling	Behavioural responses to the noise related to drilling (moving away from the location of decommissioning operations)	Low
	Vessel collisions and breakdown	Pollution caused by the breakdown or collision of vessels used during the decommissioning phase (e.g. fuel leak)	Moderate
Grey seal <i>Halichoerus grypus</i>	Waterjet cutting	Behavioural response to the noise related to the waterjet cutting of a large-diameter pile (moving away from the location of decommissioning operations)	Low
	Noise related to navigation	Behavioural responses to the noise related to navigation (moving away from the location of decommissioning operations)	Low
	Drilling	Behavioural responses to the noise related to drilling (moving away from the location of decommissioning operations)	Low
	Vessel collisions and breakdown	Pollution caused by the breakdown or collision of vessels used during the decommissioning phase (e.g. fuel leak)	Moderate
Harbour seal <i>Phoca vitulina</i>)	Waterjet cutting	Behavioural response to the noise related to the waterjet cutting of a large-diameter pile (moving away from the location of decommissioning operations)	Low
	Noise related to navigation	Behavioural responses to the noise related to navigation (moving away from the location of decommissioning operations)	Low
	Drilling	Behavioural responses to the noise related to drilling (moving away from the location of decommissioning operations)	Low
	Vessel collisions and breakdown	Pollution caused by the breakdown or collision of vessels used during the decommissioning phase (e.g. fuel leak)	Low

6.1.4.5.1.5 Migratory birds

The impact on birds during the decommissioning phase is assumed to be similar to the one estimated for the construction phase. There is little knowledge of the impacts occurring in the decommissioning phase since most of OWFs is still operating. Some conclusions can be drawn from the example of the Dutch wind farm, Lely [313], although the nature of the project was different (the wind farm was built on Lake IJsselmeer). Considering the significance of impacts occurring in the operation phase as a reference point, the scale of impacts during the construction and decommissioning phases should be many times smaller. Taking into account that the decommissioning phase does not have a permanent effect, the barrier in the form of the decommissioned power stations will decrease, and with the decreasing number of power stations, the risk of collision will also gradually decrease. On this basis, the significance of the impacts in the decommissioning phase of the project is assessed to be low or negligible [Table 6.28].

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Table 6.28. Significance of impacts related to the decommissioning phase of the wind farm on the birds migrating through the BC-Wind OWF Area; equal impacts for both variants of the OWF have been adopted [Source: BC-Wind data]

Species	Impact	Impact scale	Duration	Intensity	Impact frequency	Impact reversibility	Size of impact	Impact significance
All migratory bird species listed in Table 3.12 of moderate and high significance	Ship barrier	Local	Temporary	Low	Repeated	Reversible	Irrelevant	Low
	Collisions with vessels	Local	Temporary	Low	Repeated	Reversible	Irrelevant	Low
All migratory bird species listed in Table 3.12 of low significance	Ship barrier	Local	Temporary	Low	Repeated	Reversible	Irrelevant	Negligible
	Collisions with vessels	Local	Temporary	Low	Repeated	Reversible	Irrelevant	Negligible

6.1.4.5.1.6 Seabirds

Identification of potential impacts on seabirds during the decommissioning phase

The OWF impact on the marine avifauna in the decommissioning phase shall be similar to the one 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 would have a similar character in the case of vessel traffic, increased noise level, demolition location illumination and disturbances in the benthic communities. The specific impact of the decommissioning phase is a gradual removal of the tall OWF structures, resulting in the disappearance of the barrier blocking the access to the rich benthic communities, which shall form in the OWF Area during its operation.

With the gradual removal of the wind turbine towers, the negative impact involving the scaring away of the birds from the area occupied by the structures protruding high above the water shall decrease. An increased traffic of vessels and the noise related to the disassembly of the power station shall continue to disturb the birds. However, it should be expected that after the complete removal of all wind turbines, the area shall attract diving benthivorous birds (mainly the long-tailed duck and the velvet scoter), because in the operation period of the power station, zoobenthic communities that constitute food for these birds shall develop on the seabed of the area occupied by the wind turbines. The benthivorous birds have a very strong impact on the population of their prey, leading to a significant reduction in the prey abundance and biomass [156, 254]. The decrease in the abundance of birds in the area occupied by the power stations during their operation shall result in a high zoobenthos biomass, since their populations shall not be exploited by birds as much as would be the case during their normal presence in the sea area. This effect shall probably be temporary in nature, however, it is difficult to predict for how long the area left after the power station removal shall constitute an attractive feeding ground for this group of birds.

To identify the significance of the impact, its scale was assessed to be high for the long-tailed duck, the velvet scoter and the common scoter, moderate for the razorbill and the common guillemot and irrelevant for the European herring gull.

The factors identified and the assessment of their impact on the marine avifauna in the decommissioning phase are presented below.

Vessel traffic

Demolition works shall involve the presence of various types of vessels that shall disturb seabirds with their physical presence, emission of noise and light. The impact scale shall be similar to the one in the project construction phase. The impact shall gradually decrease with the progress of demolition works.

For all the species assessed, the traffic of vessels constitutes a negative impact subject to cumulation. For the razorbill, the common guillemot, the European herring gull, the velvet scoter and the common scoter this is a direct and medium-term impact, and for the long-tailed duck it is assessed to be temporary and short-term. Except for the European herring gull, whose sensitivity to the impact was assessed to be low, birds are highly sensitive to the traffic of vessels.

The significance of the impact varies for individual species and it is assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot as well as important for the duck species analysed – the long-tailed duck, the velvet scoter and the common scoter.

Emission of noise and vibrations

The presence and movement of construction vessels during the demolition works shall constitute the main reason for seabird disturbance in the sea area covered by the BC-Wind OWF development. This impact shall be much greater than other pressures connected to the construction phase, such as, for example, underwater noise emission. Noise and vibrations in the decommissioning phase are direct, negative impacts on seabirds of local range, medium-term, reversible, repeatable during the decommissioning period, and of species-dependent intensity.

The sensitivity to the impact was assessed to be low for the European herring gull and high for the other bird species.

The significance of the impact varies for individual species and it is assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot as well as important for the duck species analysed – the long-tailed duck, the velvet scoter and the common scoter.

The impact shall gradually decrease with the progress of demolition works.

Lighting of the project site

During migration, birds navigate in relation to natural light sources such as stars and the sun. It has been observed that at night birds also fly towards lighthouses, drilling rigs and other structures illuminated with artificial light [501]. The illumination of the project location in the decommissioning phase shall cause direct, negative impact on seabirds of local range (for the long-tailed duck of regional range, due to the possible impact on the species biogeographical population), medium-term, reversible, repeatable during the decommissioning period, and of species-dependent intensity.

The sensitivity to the impact was assessed to be low for the European herring gull and high for the other bird species.

The significance of the impact varies for individual species and it is assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot as well as important for the duck species analysed – the long-tailed duck, the velvet scoter and the common scoter.

The impact shall gradually decrease with the progress of demolition works.

Barrier creation

The construction structures during the OWF decommissioning works and the presence of vessels necessary for supporting the OWF decommissioning works shall be a source of direct, negative impacts on the seabirds, which shall be of local range, reversible, repeatable in the decommissioning phase, as well as of species-dependent intensity.

The sensitivity to the impact was assessed to be low for the European herring gull and high for the other bird species.

The significance of the impact varies for individual species and it is assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot as well as important for the duck species analysed – the long-tailed duck, the velvet scoter and the common scoter.

The impact shall gradually decrease with the progress of demolition works.

Collisions with vessels

Collisions of seabirds with vessels are possible during the decommissioning phase of the planned project. The impact scale shall be similar to the one in the project construction phase. For all the species analysed, collisions with vessels constitute negative impacts which are subject to cumulation. For the razorbill, the common guillemot, the European herring gull, the velvet scoter and the common scoter this is a temporary or short-term impact, and for the long-tailed duck it is permanent or long-term.

The sensitivity to the impact was assessed to be low for the European herring gull and high for the other bird species.

The significance of the impact varies for individual species and it is assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot as well as important for the duck species analysed – the long-tailed duck, the velvet scoter and the common scoter.

The impact shall gradually decrease with the progress of demolition works.

Destruction of benthic habitats

The destruction of benthic habitats during the demolition works poses an indirect, negative impact on some of the seabirds (mostly benthivorous birds), which is of local range, medium-term, reversible, repeatable in the decommissioning period (for each of the wind turbines or infrastructure elements), with a species-dependent intensity. The scale of the impact shall mainly depend on the number of foundations or support structures of wind power turbines, their type and size.

The sensitivity to the impact was assessed to be irrelevant for the European herring gull, moderate for the razorbill and the common guillemot, and high for the long-tailed duck, the velvet scoter and the common scoter.

The significance of the impact varies for individual species and it is assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot as well as low for the duck species analysed – the long-tailed duck, the velvet scoter and the common scoter.

The impact shall gradually decrease with the progress of demolition works, and the habitats destroyed shall be restored within several years from the moment of the work completion.

Increase in the content of suspended solids in the water

These factors may affect the ability of diving benthivorous and piscivorous birds to find food. During the OWF decommissioning, the seabed sediments shall be raised and the content of the suspended solids shall increase. The impact scale shall be similar to the one in the project construction phase.

For all the bird species assessed, this is a direct, negative impact subject to cumulation. For the razorbill, the common guillemot, the European herring gull, the velvet scoter and the common scoter this is a temporary or short-term impact, and for the long-tailed duck it is long-term or permanent.

The sensitivity to the impact was assessed to be irrelevant for the European herring gull, moderate for the razorbill and the common guillemot, and high for the long-tailed duck, the velvet scoter and the common scoter.

The significance of the impact varies for individual species and it is assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot as well as low for the duck species analysed – the long-tailed duck, the velvet scoter and the common scoter.

The impact shall gradually decrease with the progress of demolition works.

Deposition of the sediment disturbed

These factors may affect the ability of diving benthivorous and piscivorous birds to find food. During the OWF decommissioning, the seabed sediments shall be disturbed and the concentration of the suspended solids shall increase. The impact scale shall be similar to the one in the project construction phase.

For all the bird species assessed, this is a secondary, negative impact subject to cumulation. For the razorbill, the common guillemot, the European herring gull, the velvet scoter and the common scoter this is a medium-term impact, and for the long-tailed duck it is assessed to be long-term or permanent.

The sensitivity to the impact was assessed to be irrelevant for the European herring gull, moderate for the razorbill and the common guillemot, and high for the long-tailed duck, the velvet scoter and the common scoter.

The significance of the impact varies for individual species and it is assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot as well as low for the duck species analysed – the long-tailed duck, the velvet scoter and the common scoter.

The impact shall gradually decrease with the progress of demolition works.

Table 6.29 presents the compilation of impacts of the BC-Wind OWF on seabirds during the decommissioning phase.

Table 6.29. Significance of the project impact on seabirds during the decommissioning phase [Source: internal materials]

Species	Impact significance
European herring gull <i>Larus argentatus</i>	Negligible
Razorbill <i>Alca torda</i>	Moderate
Common guillemot <i>Uria aalge</i>	Moderate
Velvet scoter <i>Melanitta fusca</i>	Important
Long-tailed duck <i>Clangula hyemalis</i>	Important
Common scoter <i>Melanitta nigra</i>	Important

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:

- the removal of OWF elements;
- the presence of vessels;
- dismantling works under and above the sea surface.

The removal of the OWF elements and the 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 [344]. This may lead to a risk of collision with vessels and structures intended for removal. The vessels and the OWF elements to be removed may serve as resting sites for migratory bats [3].

Surveys conducted in the autumn and spring migration periods indicated a possibility of bats migrating in the OWF Area. However, the migration intensity was low due to the low activity of bats.

Impacts on bats during the decommissioning phase will be negative, direct, local, short-term, temporary and of low intensity.

The sensitivity to the impact was assessed to be low, whereas the significance of the BC-Wind OWF impact during the decommissioning phase was assessed to be negligible due to the low activity of bats found during the surveys carried out in the seasonal migration periods.

6.1.4.5.2 Impact on protected areas

6.1.4.5.2.1 Impact on protected areas other than Natura 2000 sites

Due to the location of the BC-Wind 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 has been established, such as biodiversity, resources, objects and elements of inanimate nature and the landscape of the park.

In the appendix to the Regulation of the Minister of the Environment of 16 February 2017 on the protection tasks for the Słowiński National Park (Official Journal of the Ministry of the Environment 2017, item 10, as amended), in which the existing and potential internal and external hazards, as well as the methods of elimination or reduction of such hazards and their effects have been identified, as one of the existing internal hazards, a hazard has been indicated resulting from the expansion of the areas intended for the development of wind farms in the park neighbouring municipalities. In terms of potential external hazards, it has been indicated that only the erection of wind farms in the park buffer zone constitutes a potential external hazard, and thus, it should be concluded that the BC-Wind OWF shall not pose a hazard to the Słowiński National Park.

6.1.4.5.2.2 Impact on the Natura 2000 protected areas

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 issue of the wildlife corridors in the sea areas is described in subsection 6.1.1.4.3.

With reference to seabirds, the impact of the OWF decommissioning process on the wildlife corridors shall have the opposite effect compared to the construction phase. With the removal of the individual structural elements from the space, the possibility of free migration for birds shall increase.

6.1.4.5.4 Impact on biodiversity

Phytobenthos and macrozoobenthos

Due to the decommissioning of the underwater structures of the OWF, the macrozoobenthos complex which re-colonised the seabed around the foundations and along the cable routes in the operation

phase will be destroyed which may results in the deterioration of the qualitative and quantitative structures of this group of organisms. However, the local range of this impact should not affect the biodiversity of the macrozoobenthos complex inhabiting the entire seabed area of the BC-Wind OWF. The removal of the artificial substrates will have a greater negative impact on the biodiversity (habitat and taxonomic) and the local reduction of benthos resources constituting the new food supply for fish and seabirds in terms of plant and animal periphyton complexes which will have grown on these structures during approximately 20 to 25 years of the OWF lifetime [236]. On the other hand, the original natural state of the seabed habitats in the area of this OWF will be restored.

Ichthyofauna

Works related to OWF 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

Having in mind the available information and data, it is assumed that the decommissioning phase will have no negative impact on the biodiversity of marine mammals in the survey area and in the neighbouring waters.

Seabirds

The analysis of the possible impacts resulting from the demolition activities conducted in the OWF decommissioning phase indicates that their effects shall be short-term, local and reversible. This applies to all types of emissions (noise, suspended solids and the release of nutrients from the sediments). The intensity of environmental impact will decrease as the distance from their source increases. Mobile species (fish, marine mammals, birds) shall avoid the space in which they encounter a deterioration in their optimum conditions. Due to the time-limited animal-scaring effect for these species and the large volume of space in the marine environment, once the emissions cease and the previous habitat conditions are restored, the species (fish, marine mammals) shall return to the area from which they were displaced or they shall use adjacent areas. Demolition works shall result in the restoration of the previous conditions in the habitat, modified due to the OWF construction. Therefore, the restoration of the qualitative and quantitative structure of zoobenthos to the pre-project condition is expected.

As a result of the project implementation, the fragmentation of the sea habitat, in which the isolation of the populations permanently or temporarily associated with the BC-Wind OWF Area and the adjacent sea areas, shall not occur.

As a result of the construction works conducted, no direct or indirect destruction of the benthic and pelagic habitats shall occur, which could, in consequence, lead to the extinction of the species living there. Also, as a result of the work conducted, no physical barriers which the marine organisms would be unable to overcome shall be created.

With the above in mind, it can be stated that the OWF decommissioning phase may lead to a short-term change in the number of species residing 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 movement of individuals does 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.

The impact of the project discussed on biodiversity can be considered as low.

6.1.4.6 Impact on cultural values, monuments and archaeological sites and objects

The presence of anthropogenic objects was recorded in the BC-Wind OWF Area. As of the date of submission of the EIA Report, there is no confirmation that these structures have cultural values, nor have they been entered into the register of monuments. There are no archaeological sites either.

If it is found that anthropogenic objects present in the BC-Wind OWF Area have cultural values or are monuments, the significance of the impact is assessed to be 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 use and development of the sea area and tangible property

At present, the BC-Wind OWF Area is not intensively used by other users (i.e. fishery, raw materials). However, a ferry navigation takes place along the north-eastern boundary of the BC-Wind Development Area. For these reasons, the clearance of the area as a result of the OWF decommissioning will be of low significance to the elements mentioned. Accordingly, the significance of the impact was assessed to be negligible.

6.1.4.8 Impact on landscape, including the cultural landscape

The impact of the OWF on the landscape in the BC-Wind 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 the OWF decommissioning, the landscape on the sea surface within the OWF Area will return to the condition before the 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 BC-Wind OWF on 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

The 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 the 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 turbines and other structures of the BC-Wind OWF, will be close to those involved in the construction, i.e. approximately 400 cruises.

At the same time, it should be emphasised that the routes of these additional cruises of technical vessels dedicated to the OWF decommissioning, moving between the BC-Wind OWF and small ports

of the central coast and deep-water ports of, for example, the Tricity, will cross the routes of vessels cruising along the navigation routes of the Southern Baltic.

Similarly to the construction phase, fishing activities in parts of statistical rectangles N7, N8, O8 and P8 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 BC-Wind 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 BC-Wind OWF, and its gradual decommissioning will only increase the availability of the BC-Wind OWF sea 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. From the point of view of the impact significance, the variants differ mainly in two key parameters, i.e. the maximum number of wind turbines and the maximum rotor diameter [Table 2.3]. These two essential parameters of the BC-Wind OWF can generate various impacts on the environment.

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. Only in the case of the impact assessment of collision risk on migratory birds for the operation phase, differences were found in the modelling results obtained for the APV and the RAV variants. The collision modelling indicated an identical or higher risk of migratory bird collisions for the RAV variant. However, these higher collision risk levels for the RAV variant did not increase the significance of the impact. A detailed assessment of the BC-Wind OWF impact on migratory birds for the APV and the RAV variants is included in Appendix 4 to the EIA Report.

6.3 Impact assessment for Natura 2000 sites

6.3.1 Initial assessment

The primary objective of the 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 BC-Wind 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.

Detailed information on Natura 2000 sites located in a direct or further vicinity of the BC-Wind OWF Area is presented in Section 0.

The essential element of the preliminary assessment of the BC-Wind OWF impact on the Natura 2000 sites is to determine whether a given Natura 2000 site is within the range of the potential impacts of

the BC-Wind OWF. The location of the BC-Wind OWF Area against the background of the location of Natura 2000 sites is presented in 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. Table 6.30 shows distances (understood as distances from the nearest points of both areas) of Natura 2000 sites from the BC-Wind OWF Area and a list of the subjects of protection present in these areas.

Table 6.30. Marine and coastal Natura 2000 sites located closest to the BC-Wind OWF [Source: internal materials]

Area name/code	Distance from the BC-Wind OWF Area [km]	Subjects of protection in the area		
		Marine habitats	Species of marine animals	Bird species
Przybrzeżne wody Bałtyku (PLB990002)	11.45	-	-	Long-tailed duck (A064) Common scoter (A065) Velvet scoter (A066) European herring gull (A184) Razorbill (A200) Black guillemot (A202)
Ostoja Słowińska (PLH220023)	37.0	Rocky seabed, reefs (1170)	Sea lamprey (1095) River lamprey (1099) Twaite shad (1103) Salmon (1106) Porpoise (1351) Grey seal (1364) Sichel (2522)	-
Słupsk Bank (PLC990001)	43.13	Submarine sandbanks (1110) Rocky seabed, reefs (1170)	-	Long-tailed duck (A064) Black guillemot (A202)
Hoburgs bank och Midsjöbankarna (SE0330308)	63.6	Submarine sandbanks (1110) Rocky seabed, reefs (1170)	Porpoise (1351)	Common eider (A063) Long-tailed duck (A064) Black guillemot (A202)

Additionally, Table 6.30 distinguishes the species of birds and other marine animals which are subject to protection in at least two areas. The species identified include the harbour 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 in 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: Przybrzeżne wody Bałtyku (PLB990002), Słupsk Bank (PLC990001) and Hoburgs bank och Midsjöbankarna (SE0330308). In the case of the European herring gull, which is protected in the Przybrzeżne wody Bałtyku (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 harbour porpoise (1351) is not a migratory species. It uses the area it stays in also for 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 [440, 103].

6.3.1.1 Determination of project impact ranges

The BC-Wind OWF Area is located outside the areas of the European Natura 2000 network [Table 6.30]. Therefore, when determining the impact of the planned project on Natura 2000 sites, impacts extending beyond the BC-Wind OWF Area were assumed. The identification and assessment of impacts on particular elements of the environment are presented in Subsections 6.1 and 6.2. Table 6.31 below shows the impacts that may extend beyond the BC-Wind OWF Area and protected elements of Natura 2000 sites that may be affected by these impacts.

Table 6.31. List of impacts and affected elements of Natura 2000 sites [Source: internal materials]

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 suspension of $4 \text{ mg} \cdot \text{dm}^{-1}$ concentration is approx. 6.5 km from its origin;
- the maximum range of the suspended solids sedimentation area with a thickness of 2 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 roe 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 $10\text{--}12 \text{ mg} \cdot \text{dm}^{-1}$, and already with a suspended solids content of $3\text{--}5 \text{ mg} \cdot \text{dm}^{-1}$ 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 $4 \text{ mg} \cdot \text{dm}^{-1}$.

The destruction of benthic organisms could indirectly affect the deterioration of the food supply for birds. To determine the extent of the significant impact of the suspended solids sedimentation, a value of 1.5 mm of the deposited sediment was adopted cautiously, assuming that dissolved oxygen in the process of diffusion reaches up to 2 mm within the sediment depth [174].

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) within the Słupsk Bank site (PLC990001) as well as Reefs (1170) within the Ostoja Słowińska (PLH220023). 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 the laying of cables within

the BC-Wind 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 BC-Wind 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].

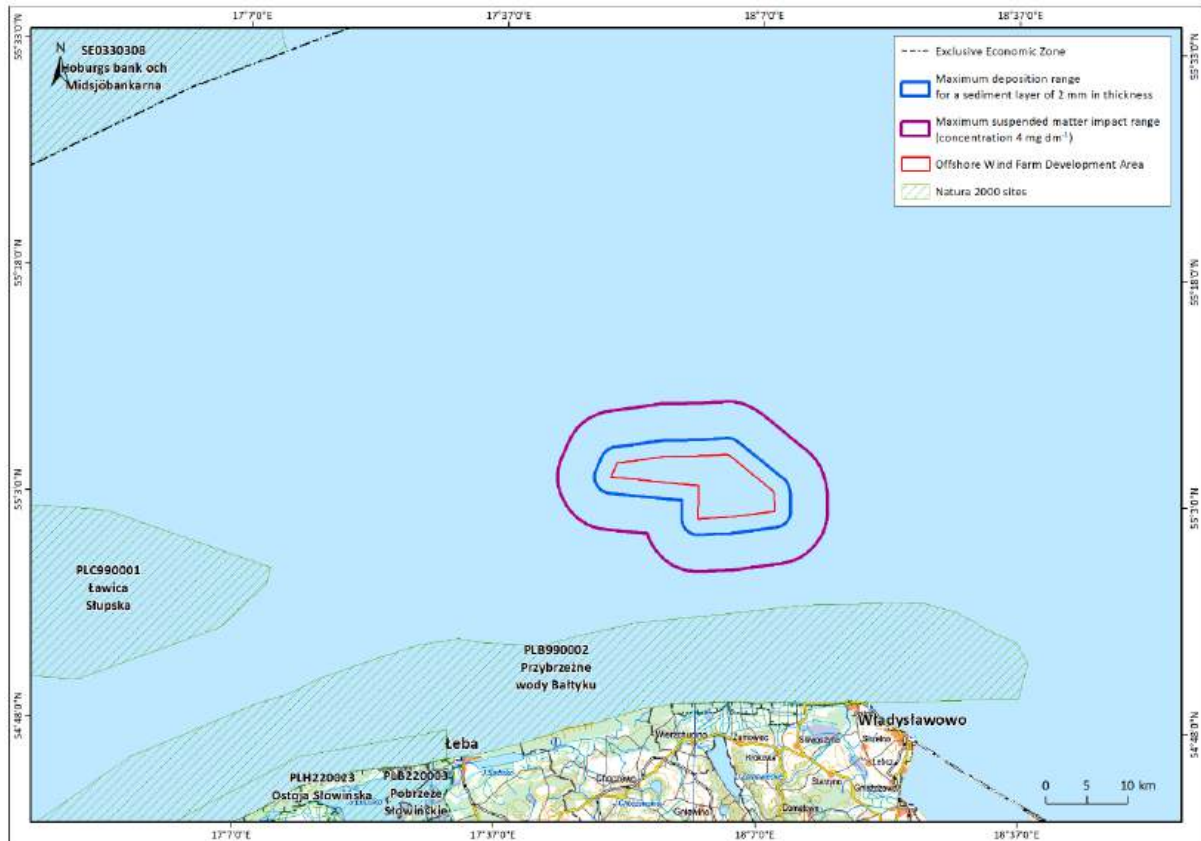


Figure 6.4. Range of impact of the increase in suspended solids content and the resulting sedimentation for the BC-Wind OWF [Source: internal materials]

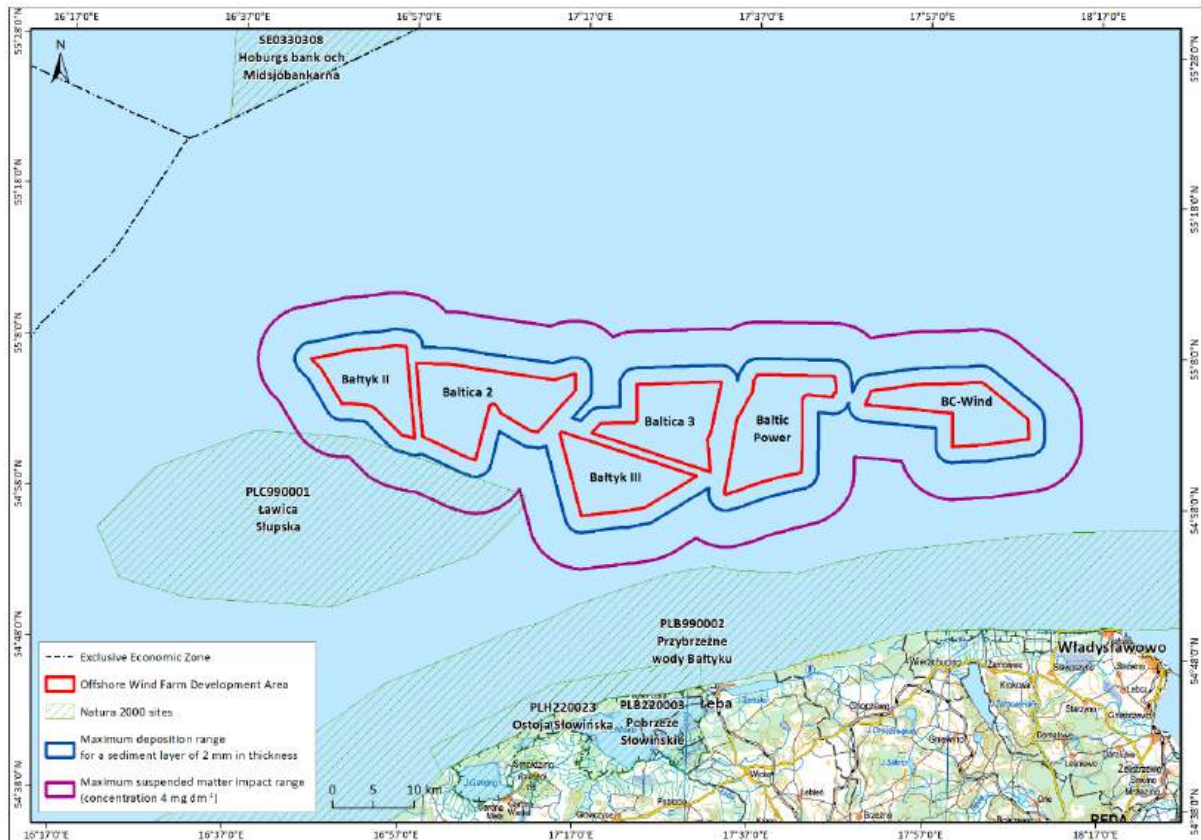


Figure 6.5. Range of impact of the increase in suspended solids content in water and the resulting sedimentation cumulative for the BC-Wind OWF and other OWFs [Source: internal materials]

6.3.1.1.2 Underwater noise

The ranges of the underwater noise impact on marine mammals and fish generated as a result of single piling in the BC-Wind OWF Area, and as a result of simultaneous piling in the area of the following OWFs: the BC-Wind, Baltic Power, Baltica 2, Baltica 3, Bałtyk II and Bałtyk III (when at least one pile driving is taking place in the BC-Wind OWF Area) were determined using numerical modelling of sound propagation. The worst-case scenario was taken into consideration for the modelling of pile driving in the BC-Wind OWF Area.

The detailed methodology of determining underwater noise impact ranges caused by pile driving and the results of the analyses conducted are presented in Appendix 1 and Appendix 2 to the EIA Report.

In order to prevent the impact on the Natura 2000 sites, the underwater noise levels should be safe for the species already present at the boundaries of the areas designated. The Noise Reduction System, which is an integral part of the BC-Wind OWF in the construction phase, is intended to reduce the noise generated during pile driving to such a degree that it did not exceed the TTS (1-h cumulative) value within the boundaries of the Natura 2000 site, in which marine mammals are the subject of protection [Table 6.32]. Both the harbour porpoise and the grey seal constitute the basis for determining the Natura 2000 sites and are counted as species listed in Annex II to the Directive 92/43/EEC [223].

Table 6.32. Natura 2000 sites with a seabird protection status located in the immediate vicinity of the BC-Wind OWF [Source: internal materials]

Natura 2000 Code	Name of the sites	Onshore/Offshore Area	Surface area [km ²]	Approximate distance from the BC-Wind OWF Area central point [km]
SE0330308	Hoburgs bank och Midsjöbankarna	Offshore	1226	69.4
PLH220023	Ostoja Słowińska (PLH220023)	Offshore/Onshore	321	43.2

The impact of underwater noise on marine mammals is presented in Subsection 6.1.1.4.1.4.

The PTS (1-hour cumulative) and TTS (1-hour cumulative) ranges as well as the behavioural responses for the harbour porpoise and seals after the application of mitigation measures in the form of an NRS are presented in figures [Figure 6.6, Figure 6.7]. Both, in the case of the harbour porpoise as well as seals, these ranges do not reach the boundaries of the Ostoja Słowińska (PLH220032) and Hoburgs bank och Midsjöbankarna (SE0330308) sites, in which these mammals are the subject of protection.



Figure 6.6. Impact range of underwater noise from single pile driving in the BC-Wind OWF Area for the harbour porpoise with the application of an NRS [Source: internal materials]

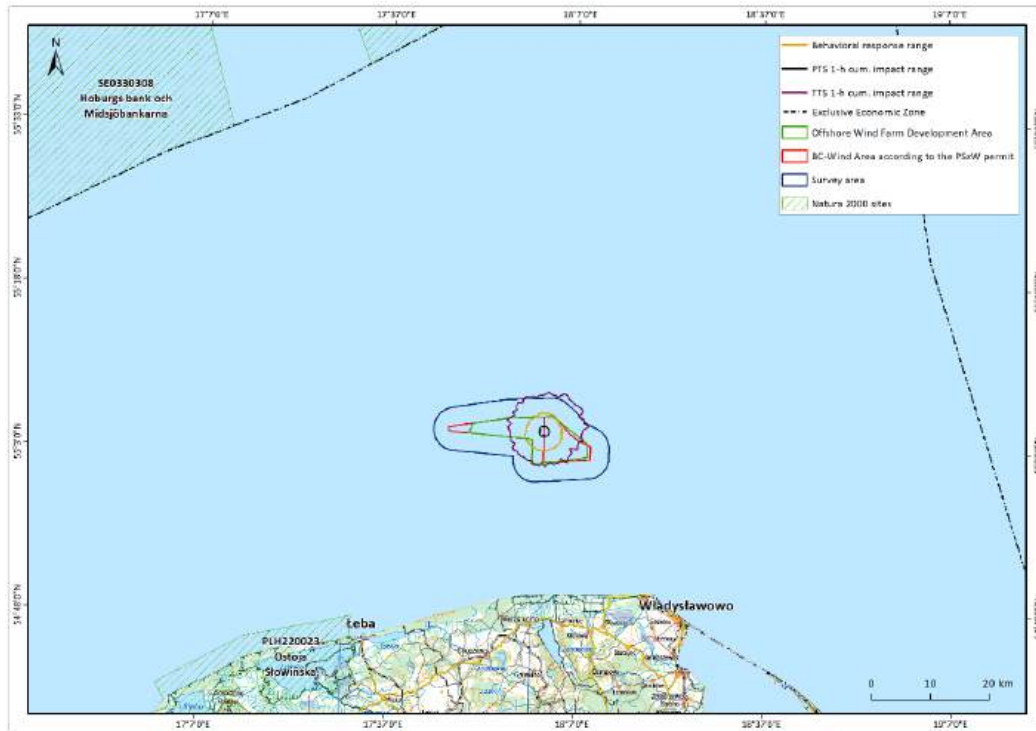


Figure 6.7. Impact range of underwater noise from single pile driving in the BC-Wind OWF Area for the seals with the application of an NRS [Source: internal materials]

The preliminary assessment also included the impacts of cumulative noise generated at simultaneous installation of the OWF foundations in several locations (both, only in the BC-Wind OWF Area, as well as in connection with other OWFs being implemented). In the case of cumulative impacts, taking into consideration simultaneous pile driving in: a) two locations close to each other, b) two locations at a distance of 20 km away from each other – the ranges for all three types of impact (PTS 1-hour cum., TTS 1-hour cum., behavioural response) did not reach beyond the boundaries of the Ostoja Słowińska (PLH220032) and Hoburgs bank och Midsjöbankarna (SE0330308) sites, both for the harbour porpoise and for seals [Figure 6.8–Figure 6.11].

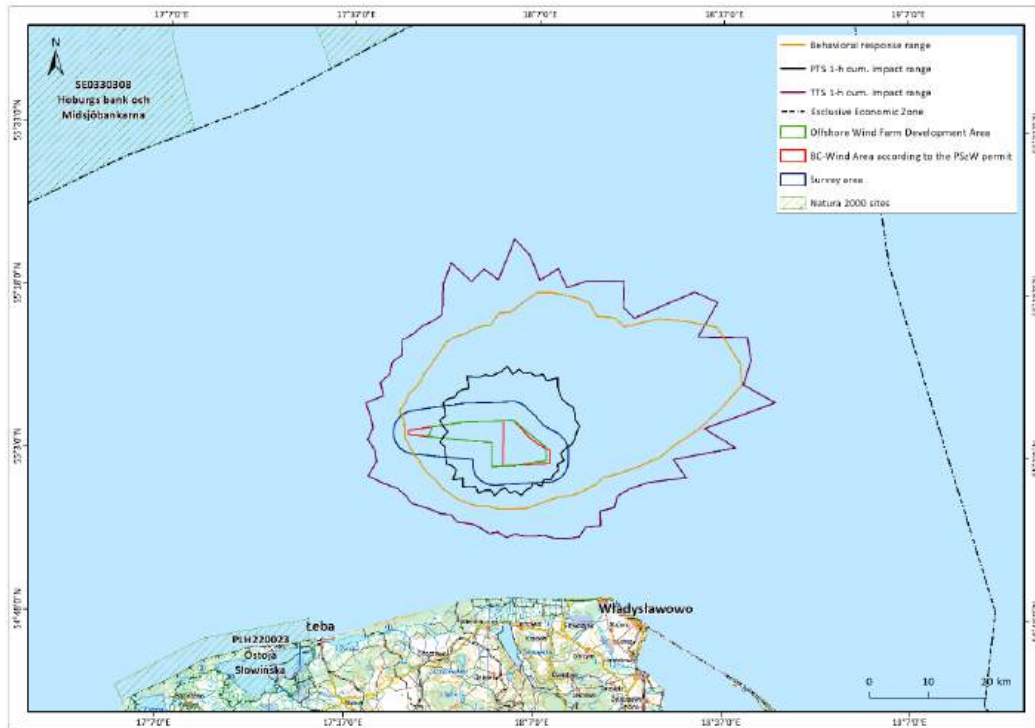


Figure 6.8. Impact range of underwater noise for the harbour porpoise as a result of simultaneous pile driving in two locations for the areas located close to each other, with the application of an NRS, with reference to the Natura 2000 sites [Source: internal materials]

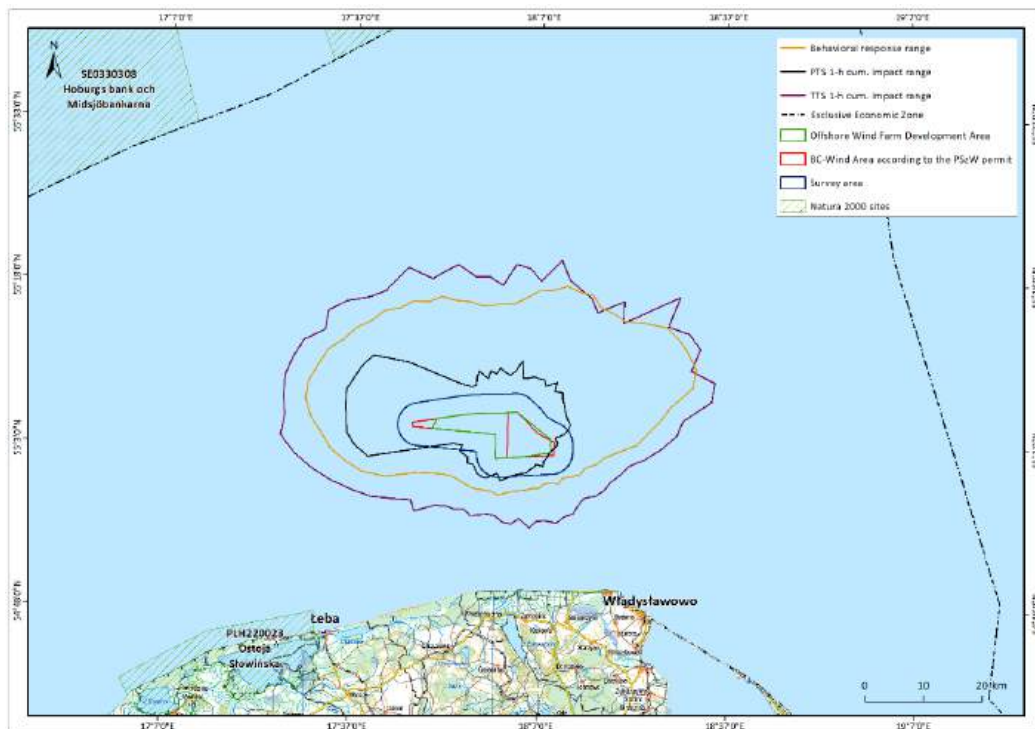


Figure 6.9. Impact range of underwater noise for the harbour porpoise as a result of simultaneous pile driving in two locations for the areas located at a distance of 20 km away from each other, with the application of an NRS, with reference to the Natura 2000 sites [Source: internal materials]

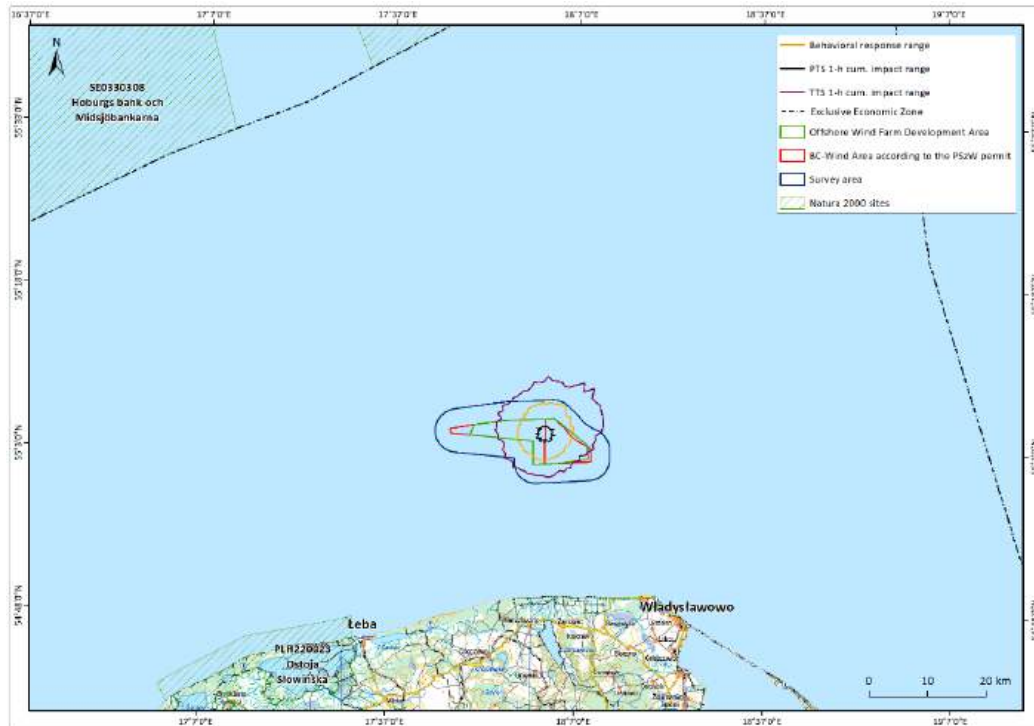


Figure 6.10. Impact range of underwater noise for seals as a result of simultaneous pile driving in two locations for the areas located close to each other, with the application of an NRS, with reference to the Natura 2000 sites [Source: internal materials]

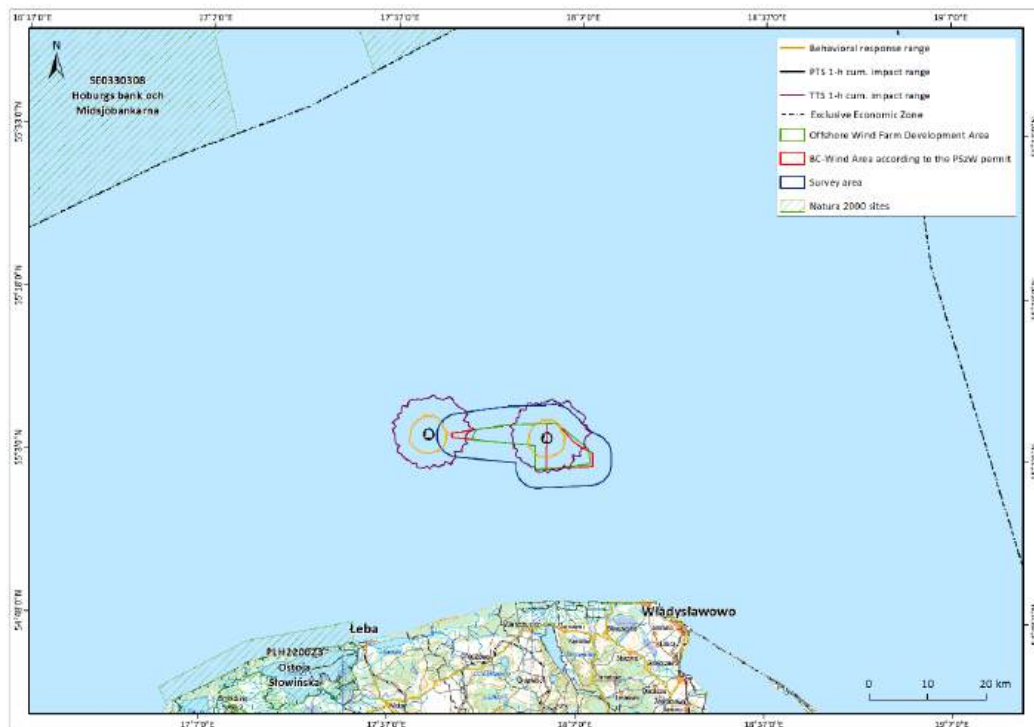


Figure 6.11. Impact range of underwater noise for seals as a result of simultaneous pile driving in two locations for the areas located at a distance of 20 km away from each other, with the application of an NRS, with reference to the Natura 2000 sites [Source: internal materials]

6.3.1.1.3 Spatial disturbances

As a result of the implementation of the BC-Wind 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 turbines will be 330 m above sea level and the maximum rotor diameter will be up to 280 m. In the Applicant Proposed Variant (APV), the maximum number of wind turbines will be 41, and the maximum number of additional structures will be up to 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 BC-Wind OWF Development Area. All structures erected will not form a uniform barrier. The distances between individual wind turbines will be at least four times the rotor diameter. For a rotor with a maximum diameter of 280 m, it will be more than 1000 m. The location of individual wind turbines 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 turbines will be up to 20 m, whereas the rotor diameter will be up to 280 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 turbine 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 [424]. A similar situation will occur in the case of marine mammals, for which the possibility of active movement means that the sparsely distributed construction elements in the sea space will not affect significantly their previous behaviour. In the case of birds sitting on the water, given the minimum distance of the rotor tips from the water surface (20 m), the restriction of the 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 flights between feeding grounds. Disturbances of these flights may affect the populations of birds subject to protection in the Natura 2000 sites – Przybrzeżne wody Bałtyku (PLB990002) and Słupsk Bank (PLC990001). In the event of a significant impact of the OWF on birds caused by the disturbance of airspace, the coherence of the Natura 2000 network could be compromised, however, such impact is not expected.

6.3.1.2 Summary of the preliminary assessment

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 BC-Wind OWF, as well as for the cumulative effect of the impacts generated by other projects, that no Natura 2000 site is situated within the range of any impacts. The lack of impacts regards, in particular, the subjects of protection (species and habitats) within these areas, for the protection of which they have been established.

In this respect, the main impact assessment of the BC-Wind OWF on Natura 2000 sites covered the aspect related to the probable impact caused by the disturbance of the airspace over the BC-Wind

OWF Development Area, in the context of integrity of the Przybrzeżne wody Bałtyku site (PLB990002) and the coherence of the Natura 2000 network.

6.3.2 Main assessment

The main assessment, due to the nature of impact, was focused on the operation phase of the BC-Wind OWF. In this phase, the airspace above the maritime area will be maximally occupied by the structures both of wind turbines and platforms, thus, the impact will be the greatest in comparison to the other phases of the project. In the construction phase, the effect of the aerial space disturbance shall be incremental: from the undisturbed, baseline state to the maximum state lasting for the duration of the entire operation phase. In the decommissioning phase, the situation shall 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 the seabird populations as part of the Natura 2000 network, the following characteristics of the Słupsk Bank (PLC990001) and Przybrzeżne wody Bałtyku (PLB990002) sites are crucial:

- the location of these sites on the migration route of the Eurasian seabird populations to their wintering grounds;
- the availability of these areas for the populations of wintering birds and birds resting during migration;
- the appropriate habitat conditions that make these sites attractive as wintering or resting grounds for seabirds during the autumn and spring migrations.

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, including the survival of the individuals from these populations.

At the moment, before the erection of the BC-Wind OWF and other OWF projects in the PMA, the status of the birds wintering and migrating in the Słupsk Bank site (PLC990001) and the Przybrzeżne wody Bałtyku site (PLB990002) is appropriate.

In the assessment of the BC-Wind OWF on the Natura 2000 sites in connection to birds, the results of ornithological surveys conducted for the EIA Report, information from the Standard Data Forms for the Słupsk Bank (PLC990001) and Przybrzeżne wody Bałtyku (PLB990002) sites, and also the recommendations from the European Commission's "Guidebook on the development of wind energy 2000" were used.

The results of the maximum abundance of the bird species selected in the BC-Wind OWF Area and the Natura 2000 network sites are presented in Table 6.33, and in Figure 6.12. The results of the abundance modelling during the seabird wintering period were used for comparison, in accordance with the accepted standards, because the long-distance movements of birds during winter are less probable than in other phenological periods.

In this respect, an assessment of the usefulness and significance to the seabirds of the BC-Wind OWF Area and the neighbouring Natura 2000 sites the Słupsk Bank (PLC990001) and Przybrzeżne wody Bałtyku (PLB990002) was conducted.

Table 6.33. Comparison of the abundances of wintering seabirds in the BC-Wind OWF Area and Natura 2000 sites [Source: internal materials]

Species	Abundance of birds wintering in the areas [ind.]			
	BC-Wind OWF	Słupsk Bank (Ławica Słupska) (PLC990001)	Fragment of the Przybrzeżne wody Bałtyku site (PLB990002)	Total
Long-tailed duck <i>Clangula hyemalis</i>	62	139 086	20 467	159 677
Velvet scoter <i>Melanitta fusca</i>	3	8 859	84 246	93 108
Razorbill <i>Alca torda</i>	288	459	756	1503
European herring gull <i>Larus argentatus</i>	631	2 148	4788	7567
Black guillemot <i>Cephus grylle</i>	1*	14*	0*	15*
Common scoter <i>Melanitta nigra</i>	0*	0*	142*	142*
Total	985	150 566	110 399	261 950

*Field survey results

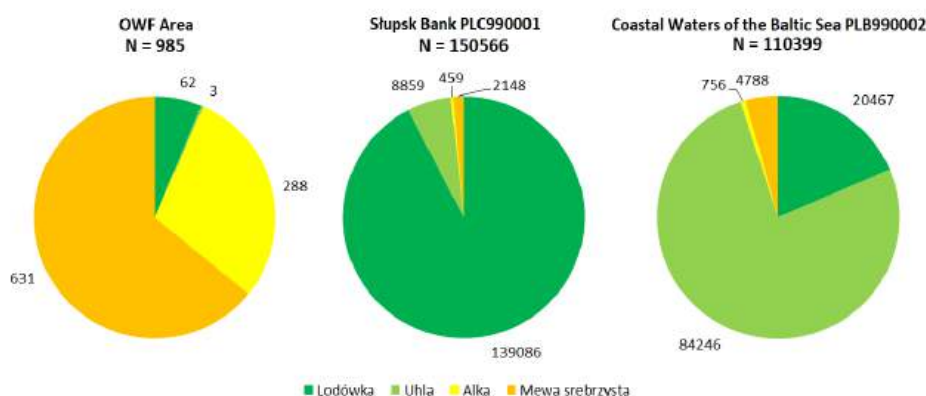


Figure 6.12. Species structure of the seabirds subject to protection within the BC-Wind OWF Area and the Natura 2000 sites [Source: internal materials]

The results of the modelling for the maximum abundances of the wintering seabirds that are the subject of protection in the Natura 2000 sites (the long-tailed duck, velvet scoter, razorbill and the European herring gull) were carried out as part of the EIA Report. The black guillemot and the common scoter were also included in the assessment. 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 BC-Wind OWF Area was very low. In total, only one single individual was recorded during the winter survey campaigns. No individual of the black guillemot species was found in the Przybrzeżne wody Bałtyku (PLB990002) site, and in the Słupsk Bank (PLB990001) site 14 individuals were recorded. It should be underlined that these abundances apply only to the individuals observed along the survey cruise route and that they are not identical with the total number of black guillemots residing in these areas.

The common scoter is the subject of protection in the Przybrzeżne wody Bałtyku (PLB990002) site and its abundance in winter in this survey area was 142 individuals observed along the survey cruise route. It was not recorded in the BC-Wind OWF Area.

The wintering period was assessed to be being representative, because the long-distance travels of birds in the wintering period are much less probable than in other phenological periods, and the bird abundances are the highest. The Słupsk Bank (PLC990001) and the Przybrzeżne wody Bałtyku (PLB990002) sites are located on the route of Eurasian seabird populations migration to their wintering grounds. Their distribution and the abundance of birds result mainly from the availability of food. From the point of view of the habitat conditions, which make these areas attractive, the results obtained clearly indicate that the BC-Wind OWF Area is used by birds much less in contrast with the Natura 2000 sites. This confirms the value and importance of the areas included in the Natura 2000 network. Seabirds show strong attachment to their wintering grounds and are reluctant to travel greater distances [190, 215, 320]. Surveys of birds in flight using a radar have shown that wintering birds flying in this part of the Baltic Sea move in all directions, without a clear pattern, which indicates short foraging flights rather than long-distance travels. It has been found that at the vantage points located along the Przybrzeżne Wody Bałtyku site, birds fly more frequently in the west-south and north-east directions, i.e. along the shoreline. The highest number of flights recorded was documented in the strip between the Natura 2000 sites the Słupsk Bank and the Przybrzeżne Wody Bałtyku.

Although the availability of the BC-Wind 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 to be negligible for the long-tailed duck and the European herring gull, while for the black guillemot and the common scoter the impact will be absent. Furthermore, the existence of corridors (development-free areas) to the west of the BC-Wind Development Area (between the Baltic Power OWF and BC-Wind OWF) and between the Baltica 2 OWF and Baltica 3 OWF will significantly increase the flight possibility for birds migrating within the area of wind farms in this region.

European herring gulls gather in the open sea areas where fishing is conducted by the fishing boats. If during the construction (or later operation) of the BC-Wind OWF, fishing becomes restricted in this sea area, seagulls may relocate to a different location, in which fishing will be continued or may use the new structural elements protruding from the sea as their resting places. The underwater parts of these structures shall fulfil the function of an artificial reef constituting a hard substratum for the macrozoobenthos – the food for birds.

Long-tailed ducks, velvet scoters, and razorbills present in the BC-Wind OWF Area before the commencement of work, shall in majority permanently abandon this area, relocating to the neighbouring areas. Populations wintering in the areas of the Słupsk Bank (PLC990001) and the Przybrzeżne wody Bałtyku (PLB990002), where the habitats are better, are not at risk due to the significant distance of these areas from the BC-Wind OWF Area. The potential possibility of an increase in the densities of the long-tailed duck, the velvet scoter and the razorbill at both Natura 2000 sites as a result of the movement of birds previously staying in the sea area of the planned project will not have a negative impact on them. In the planned OWF Area, these species occupied suboptimal habitats, mainly due to the too great depth for diving in search of food. On the other hand, at the Natura 2000 sites, the foraging conditions for the above-mentioned species are optimal, which is indicated by the very high values of their densities.

Summing up, it should be stated that due to the low number of seabirds in the area of the planned project, no significant negative impacts of the BC-Wind OWF, consisting in displacement from habitats of the bird species which are the subject of protection within the Słupsk Bank (PLC990001) and the Przybrzeżne wody Bałtyku sites is expected.

6.3.2.2 Integrity of the Natura 2000 site

Due to the location of the BC-Wind OWF, the issue of the impact of the planned project on the integrity of Natura 2000 site could be considered in the context of the nearest Natura 2000 site, i.e. the Przybrzeżne Wody Bałtyku site (PLB990002).

The key impacts of the BC-Wind OWF on the long-tailed duck is the ducks being scared away and the loss of important habitats in which the species winters. As shown in the publication by Petersen *et al.* [336], a multi-annual pre- and post-implementation surveys of the Nysted OEF in Denmark prove that the long-tailed duck avoids the area of the OWF constructed. It is also significantly displaced from the 2 km zone, and to a lesser extent from the 2–4 km zone around the boundaries of the power plant development area. The decrease in abundance in the 2–4 km zone was not statistically significant.

In this context, the Przybrzeżne wody Bałtyku site (PLB990002) is located at a relatively large distance from the BC-Wind OWF Area (more than 12 km), and thus, the displacement of these birds from their habitats located in the Przybrzeżne wody Bałtyku site (PLB990002) shall not take place. Moreover, due to large distances between them and the presence of other appropriate habitats at a similar distance, it should not be expected that a large number of birds displaced from the BC-Wind OWF Area would relocate to the Przybrzeżne wody Bałtyku site (PLB990002). Therefore, it is unlikely that negative impacts of the OWF related to the increase in bird density, shall occur in the Przybrzeżne Wody Bałtyku site (PLB990002), especially that the abundance of avifauna in the BC-Wind OWF Area was low. In consequence, the negative impact on the Przybrzeżne Wody Bałtyku site (PLB990002) related to the scaring away of birds and their displacement from the habitats can be excluded.

To sum up, no significant, negative impacts of the BC-Wind OWF, resulting in the displacement of the bird species that are subject to protection within the Przybrzeżne wody Bałtyku site (PLB990002) from their habitats, are expected.

6.3.2.3 Summary of the main assessment

As a result of the main assessment of the BC-Wind OWF impact on the bird species that are 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.

7 Cumulative impacts of the planned project (including existing, currently implemented and planned projects and activities)

The assessment of the cumulative impact of the BC-Wind OWF implementation in connection with other projects took into account the existing, implemented and planned projects. In the case of the planned projects, only those for which decisions on environmental conditions had been issued, were taken into account. This enabled the comparison of the impact assessment conducted for the BC-Wind OWF with the results of assessments carried out for the remaining projects in terms of the possible cumulative effect of these impacts.

No other projects that may cause cumulative impacts are being implemented nor will be implemented in the BC-Wind 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 BC-Wind OWF will have their sources outside its area.

7.1 Existing, implemented and planned projects with the decision on environmental conditions

Within the PMA, the projects connected to the hydrocarbon and gas extractions, for which the decisions on environmental conditions have been issued, are being implemented or planned [Figure 7.1], i.e.:

- Re-injecting water into deposit, through selected, existing boreholes to crude oil Deposit B3, located in the Polish EEZ of the Baltic Sea – the existing license no. 108/94 issued by the Minister of Environmental Protection, Natural Resources and Forestry on 29 July 1994 and the "Łeba" mining area with an area of 31.168 km², which coincides with the mining area (decision no.: RDOŚ-22-WOO.6670/62-5/09/AT of 19 October 2009) (hereinafter referred to as: Deposit B3);
- The extraction of natural gas from subsea hydrocarbon Deposits B4 and B6 and its transmission to the installations of the electrical and heating power station in Władysławowo (decision no.: RDOŚ-Gd-WOO.4211.12.2014.ER.8 of 16 May 2014 (hereinafter referred to as: Deposits B4 and B6);
- The extraction of crude oil and co-occurring natural gas from Deposit B8 located in the Polish EEZ of the Baltic Sea using an offshore platform with the ability of injecting water into the bedrock (decision no.: RDOŚ-Gd-WOO.4211.16.2015.ER.6 of 11 August 2015 (hereinafter referred to as: Deposit B8).

Moreover, five projects related to the construction of an OWF with the connection infrastructure in the PMA [Figure 7.1] have been issued with the decision on environmental conditions; these are:

- the construction of the Bałtyk Środkowy III OWF (decision no.: RDOŚ-Gd-WOO.4211.12.2015.KP.22 of 7 July 2016 (Bałtyk III);
- the construction of a maritime transmission infrastructure (decision no.: RDOŚ-Gd-WOO.4211.2016.KSZ/AJ.29 of 12 March 2016;
- the construction of the Polenergia Bałtyk II OWF (decision no.: RDOŚ-Gd-WOO.4211.26.2015.KSZ of 27 March 2017 (Bałtyk II);

- the 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);
- the construction of the Baltic Power OWF (decision no.: RDOŚ-Gd-WOO.420.42.2020.AJ.21).

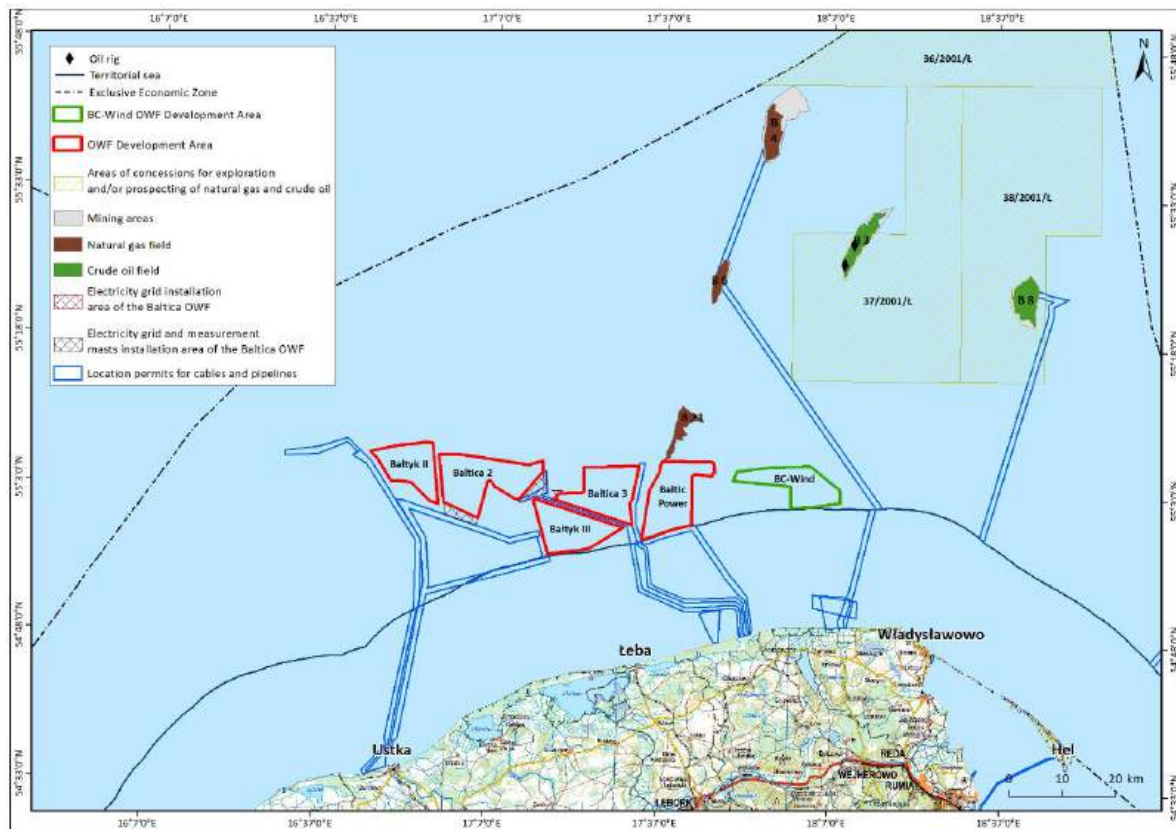


Figure 7.1. Location of the BC-Wind OWF Area among the other projects located in the Polish Maritime Areas which had been issued with the decision on environmental conditions [Source: internal materials]

At present, preparatory works are carried out before the beginning of the OWF construction phases. The projects of various Investors 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. With the general assumption of all Investors that their OWF construction phase will last several years, it cannot be indicated clearly which activities will be performed simultaneously or within a short period of time. Nevertheless, taking into account that the OWF projects of various Investors will be implemented independently, it cannot be ruled out, guided by the precautionary principle, that these impacts will not occur.

After the completion of the construction phases, the operation phases of individual OWFs will begin. Finally, the beginning of the operation phase at the last of the Investors mentioned above will generate the greatest 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 operation 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. Also, the removal of underwater structures will be a process of gradual restoration of the state before 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 in terms of the vessels used, and that all structural elements dismantled will be transported to land and disposed of there, it can be indicated that even in the case of decommissioning at the same time in several places within one or more OWFs the cumulative impacts will not occur.

7.2 Types of impacts that may cause cumulative impact

The assessment of the BC-Wind OWF impact on particular elements of the environment including the impact scale and significance is presented in section 6. The cumulative impact of the BC-Wind 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, the cases of simultaneous execution 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 BC-Wind OWF Area.

Therefore, the BC-Wind OWF impacts, which may generate a cumulative impact with other projects, include impacts that are at least medium-term and their range extends beyond the BC-Wind OWF Area, i.e.:

- underwater noise;
- the increase of suspended solids and their sedimentation;
- space disturbances, including: barriers restricting the free movement of birds, disturbances in the landscape and disturbances in radar operation as well as the restrictions on fishing.

The first two of the impacts indicated will occur during the construction phase, while the third one will occur during the operation phase.

7.3 Identification of projects which may cause cumulative impacts

The projects indicated above, which have been issued with a decision on environmental conditions can be divided into two groups, i.e. the project related to the extraction of hydrocarbons and gas and the ones related to the acquisition of energy from wind energy in offshore areas. Each of these groups of projects has specific characteristics, with different environmental impacts including their type, scope, time range and scale.

Decisions on environmental conditions for the projects related to the extraction of hydrocarbon and gas indicate the impacts and their significance. In the context of the impact that characterises the BC-Wind OWF, and which may generate a cumulative impact, the impacts of hydrocarbon and gas extraction are irrelevant since they will not cause the cumulative impact.

In the decision on environmental conditions for Deposit B8, it was indicated that the noise associated with the operation of the machines on the platform would not be emitted into the waters, and thus, no adverse impact on the surroundings or the marine environment is expected. Similarly, for Deposit B4 and B6 as well as Deposit B3, the impact of the noise generated during the work related to these projects will be irrelevant. In the case of Deposit B4 and B6, the gas pipeline construction will cause

local and temporary water turbidity only in the immediate vicinity of the works. Entries from the decisions on environmental conditions which indicate the possible impacts resulting from the implementation of these projects are presented in Table 7.1.

Table 7.1. Entries from the decisions on environmental conditions for the projects: Deposit B3, Deposits B4 and B6 and Deposit B8 regarding their impact on the environment [Source: internal materials based on the decisions on environmental conditions issued]

Project	Entries from the decisions on environmental conditions
Deposit B3	Noise emission into the environment, related to the operation of pumps and other equipment which is part of the system for purification and injection of water. The noise intensity concerns the area restricted by the drilling platform structure. Noise has no harmful effects on the surroundings and the aquatic environment and as such is not emitted into the waters around the platform
Deposit B4 and B6	As the planned boreholes will be drilled successively by the same drilling rig, no cumulative effects are anticipated due to the drilling of the planned operation boreholes in Deposits B4 and B6 with prospecting wells drilling in adjacent exploration concessions
	According to the EIA Report, the underwater noise emitted in connection with the planned work will not exceed the background parameters
	The impact on the ichthyofauna will consist of the local and temporary water turbidity increase during the excavation and the burying of the gas pipeline, which may affect particularly the individuals in the early stages of development. The discontinuation of work in the spawning season of the species inhabiting the area of works or arriving there to spawn
	No negative impact on marine mammals is expected due to their unlikely presence in the work area
Deposit B8	No negative impact of the operation of Deposit B8, including the injection of reservoir waters, on geological structure and seabed sediment pollution in the mining area is expected
	The noise associated with the operation of machines on the platform will not be emitted into the water, so no harmful effects on the surroundings and the aquatic environment are anticipated

In the case of the implementation of six OWFs, i.e. the Bałtyk III, Bałtyk II, Baltica 2 with Baltica 3, Baltic Power, Baltic II and BC-Wind, due to the analogous nature of the projects and the resulting practically identical impacts and their relatively close location, cumulative impact may occur. Each of these projects allows for a similar method of the laying of foundations for wind turbines and the development of the space above the water surface with large-size structures. Moreover, regardless of the date of the construction work commencement, the operation phase of each of these investments is planned for a period of several dozen years, which indicates that from a certain time the resulting environmental impacts may occur.

7.4 Assessment of cumulative impacts

7.4.1 Underwater noise

Marine mammals

The cumulative impacts of underwater noise in the BC-Wind OWF Area in connection to other planned OWFs, such as the Baltic Power, Baltica 2, Baltica 3, Bałtyk II and Bałtyk III, are described in Appendix 2 to the EIA Report.

The results of modelling indicate that simultaneous pile driving at two different locations (two sources), with the application of an NRS, leads to impacts on marine mammals of low to moderate degree. This means that the operation of two pile drivers in the BC-Wind OWF Area is permissible. If pile driving was to take place in the area of one of the following OWFs: the Bałtyk II, Bałtyk III, Baltica 2, Baltica 3 or Baltic Power, then additional construction works in the BC-Wind OWF Area would also

be permissible, regardless of the precise location of the works. However, three and four simultaneously operating pile drivers shall induce a significant impact on harbour porpoises.

Ichthyofauna

The maximum variant provided for the implementation of the project is two simultaneous pilings in the area covering the BC-Wind OWF as well as the Bałtyk II, Bałtyk III, Baltica 2, Baltica 3, and the Baltic Power OWFs.

The models illustrating the maximum range of behavioural response indicate a maximum of 118 km. In the case of the noise and vibrations causing TTS, the range shall not exceed 0.2 km for a single strike and 27 km for the SEL accumulated over 1 hour [Table 7.2].

Table 7.2. Summary of the ranges of distance to the threshold values for fish, obtained in the BC-Wind OWF for the noise from two sources of piling with the application of an NRS [Source: internal materials]

Effect of factor impact		SEL limit value [dB re 1 $\mu\text{Pa}^2\text{s}$]	Impact range	
			Average distance [km]	Maximum distance [km]
Fish without a swim bladder	Behavioural response	142	28	46
	TTS (single strike)	186	0.2	0.2
	TTS (1h cumulative SEL)	186	13	27
	PTS (single strike)	216	0.2	0.2
	PTS (1h cumulative SEL)	216	0.2	0.2
Fish with a swim bladder	Behavioural response	135	48	118
	TTS (single strike)	186	0.2	0.2
	TTS (1h cumulative SEL)	186	13	27
	PTS (single strike)	203	0.2	0.2
	PTS (1h cumulative SEL)	203	1.2	1.4

In addition, the use of the soft-start procedure before starting works, which aims to scare the ichthyofauna away from the area subject to impact, should additionally reduce the impact causing the TTS. For this reason, the analysis does not include the possibility of increased mortality in ichthyofauna or tissue damage. For the purposes of the cumulative analysis, the maximum variant was adopted, in which, the simultaneous piling is performed in two locations (including one location within the BC-Wind OWF), after the application of a Noise Reduction System.

The value of TTS has been adopted as the boundary of the **significant** impact of the underwater noise on organisms. In the case of the behavioural responses of organisms to the underwater noise, its effect is discontinuous, short-term and does not cause significant changes in the organism behaviour due to the acclimatisation to the conditions of increased noise [450].

Analysing the area within the **TTS impact** range (max. 27 km from the source of piling) in the context of the impact on spawning/spawning grounds, it is not a significant breeding ground for any fish species. In summer, sprat spawning can be expected there, which, at that time, takes place across the entire Baltic Sea up to a depth of 50 m.

Sprat breeds in the period from February–March to August, with the greatest intensity in the open sea, above the deep-water areas. The spawning intensity in the waters close to the shore is relatively low

[178]. An important fact is that, the sprat reproduces in large dispersion and over a large area, without forming dense spawning groups.

During the early spring period, the area subject to noise impact is part of the area where the spawning migrations of adult (sexually mature) sprats take place between the deep-water spawning grounds. In the second phase of the mass, late spring sprat spawning, the area indicated partially overlaps with the area of sexually mature fish occurrence and the roe drift in the water depth of the Baltic Sea. However, due to the relatively small impact area, it will not have a significant impact on the final effect of the reproduction process, including the size of the new generation of fish.

The significance of the impact was assessed as moderate for all the fish species examined. As far as the protected fish are concerned, during the surveys, only the larval stages occurred, for which the impact will be local.

In the transboundary context, the analysis of underwater noise indicated that the extent of the significant impact, determined by the TTS value, does not exceed the boundary of the Polish EEZ. Moreover, there is no negative impact on the condition of fish stocks, mainly due to the fact that the area analysed does not play a major role in the overall assessment of the spawning efficiency of most fish species.

Analysing the area within the behavioural reaction range (max. 46 km from the source of piling for fish without a swim bladder and 118 km for fish with a swim bladder), the occurrence of the spawning grounds of two fish species may be expected – sprat and flounder.

The spawning of flounder takes place in the near-seabed layers of the Arkona Deep, the Bornholm Deep, the Gdańsk Deep and the Słupsk Furrow at the depth of 40–80 m, where water salinity ranges from 10.7–11.7 PSU [178]. Thus, the flounder spawning may take place in the area analysed, however, only in the part the most distant from the planned works, in the northern part of the area (the Słupsk Furrow), in which the behavioural response occurs [263, 264, 265, 266, 264]. Even the complete elimination of this area from spawning in one season should not significantly affect the stock of this species, as it covers a small part of the Baltic spawning ground of flounder. The most valuable spawning grounds of this species are the Bornholm and Arkona Deeps [321].

The occurrence of the roe and larvae of other species such as herrings, gobies or ammodytids in the area analysed will result from the spawning taking place outside the area analysed, in shallow coastal waters and in the waters of the Słupsk Bank [263, 264, 265, 266, 264]. The spawning of these species directly in the area analysed is unlikely.

In the case of the spawning grounds of cod, the area within a 118 km range from the source of piling may extend to the slopes of the Gdańsk Deep.

The abundance of cod roe in water in the spawning period is the highest in the region of the Bornholm Basin. Since 1986, the Gdańsk Deep has been considered of marginal importance as the spawning ground for cod. This situation in the Gdańsk Deep is the result of insufficient salinity and oxygen content of the water [259, 227]. Since 1980s, the abundance of cod larvae is also significantly lower in the Gdańsk Deep than in the Bornholm Deep, indicating a very limited significance of the Gdańsk Deep region for the reproduction of cod [226].

The reproduction of cod takes place in the water layer below the halocline, where the hydrological conditions for the proper growth of roe such as salinity >11 PSU and oxygenation >2 ml O₂/l are met

[21, 308]. The specific water density resulting from high salinity ensures the buoyancy of roe, and at the same time enables its growth in the higher water layers with better oxygenation. Such conditions are often met in the area of the main cod spawning ground in the Bornholm Deep, in the water layers >55 m; whereas, in the Gdańsk Deep, the conditions are met only at the depth >80 m. The latest results of the NMF surveys confirm the presence of unfavourable conditions for the reproduction of cod in the recent years [355, 356].

Moreover, taking into account the propagation of sound in acoustic channels, at depths below the halocline there will no longer be noise levels capable of causing an avoidance reaction.

Summing up, the area analysed is the location of the spawning ground of the sprat and flounder, but the spawning intensity is generally low. The aforementioned possibility of the occurrence of a more intensive spawning of these two species should not have negative consequences due to the fact that it will take place only on the outskirts of the area analysed (a small area) and at a considerable distance from the sound source (the weakest impact). The fact that both species reproduce within the vast areas of the Southern Baltic and the area analysed does not play a major role in the overall approach to the spawning efficiency of these species' stocks is not without significance for the assessment of the negligible adverse impact of the planned work on the spawning grounds.

Taking into account the boundaries of the area determined on the basis of the behavioural response occurrence, the significance of the noise impact can be described as negligible.

In the transboundary context, the analysis of underwater noise indicated that the extent of the behavioural response occurrence does not exceed the boundary of the Polish EEZ. Moreover, underwater noise in terms of behavioural response has a discontinuous and short-term impact and does not cause significant changes in the behaviour of ichthyofauna, due to acclimatisation to the conditions of its increased level [450].

Impact areas for fish without a swim bladder became larger with the increasing number of simultaneously operated piling locations, but were more dependent on the distances between the sources. Overlapping of sources at average distances from one another (approx. 20 km) resulted in a significant increase of impact areas.

Impact areas for fish with a swim bladder also increased with the increasing number of locations of simultaneously operated piling, but with much greater areas of behavioural response.

7.4.2 Increase in suspended solids and their sedimentation

The issue of the increase in the concentration of suspended solids and their sedimentation in terms of the cumulative impact of the BC-Wind OWF with the Baltic Power, Bałtyk II, Bałtyk III, Baltica 2 and Baltica 3 OWFs has been described in detail in Appendix 2 to the EIA Report.

On the basis of the model calculations performed, it has been established that the cumulative effect of the increase in suspended solids content is possible as a result of various human activities during the construction phase, but the cumulative impact will be local and short-term.

Additionally, in the case of carrying out works disturbing seabed sediments in two locations 3 km apart on non-cohesive soils, the cumulative impact does not occur, and on cohesive soils, the impact is minimal.

Due to the temporal and spatial gap between the activities carried out within the OWF and in the area of the external connection infrastructure, there will be no cumulative impact resulting from the increase in the content of suspended solids and their sedimentation.

7.4.3 Spatial disturbances

7.4.3.1 Physical barrier creation

The analysis of cumulative impact should refer to the planned OWF investments in the central Baltic region (Bałtyk II, Bałtyk III, C-Wind, Baltica 2, Baltica 3, FEW Baltic II, Baltic Power), as well as to the concessions for gas and oil extraction (currently there are three exploration concessions valid in the Baltic Sea and concessions for the production of oil and gas from two fields near the BC-Wind OWF Area), since the additional structures and ships may generate additional disturbances in the environment. Potential cumulative impacts on migratory birds are the barrier effect and the risk of collision. The detailed results of the model calculations and the assessment of the physical barrier impact on migratory birds are contained in Appendix 4 to the EIA Report.

The cumulative impacts of the BC-Wind OWF with other OWFs can be expected in the case when more than one OWF is in the construction/operation/decommissioning phase at the same time, assuming that the above-mentioned projects will be implemented. The intensity and scale of these impacts are currently unknown. None of the neighbouring OWFs is under construction yet. With the construction of the last of the OWFs indicated, a maximum spatial disturbance caused by the presence of above water structures arranged over a significant area of 639.6 km² shall occur.

The gas and oil concession areas are located in deep waters, away from the planned OWFs. Extraction and related activities will concern a very small area (e.g. oil rig).

The barrier effect as an impact on the species migrating over long distances results in changes in the migration route and flight altitude, which is also associated with increased energy expenditure. In order to quantify the impact of the BC-Wind OWF barrier effect and other projects planned in this region, the migration route has been modified assuming that migratory birds will perceive the OWF areas as a physical barrier which they will bypass at a distance of approx. 1–2 km [Figure 7.2].

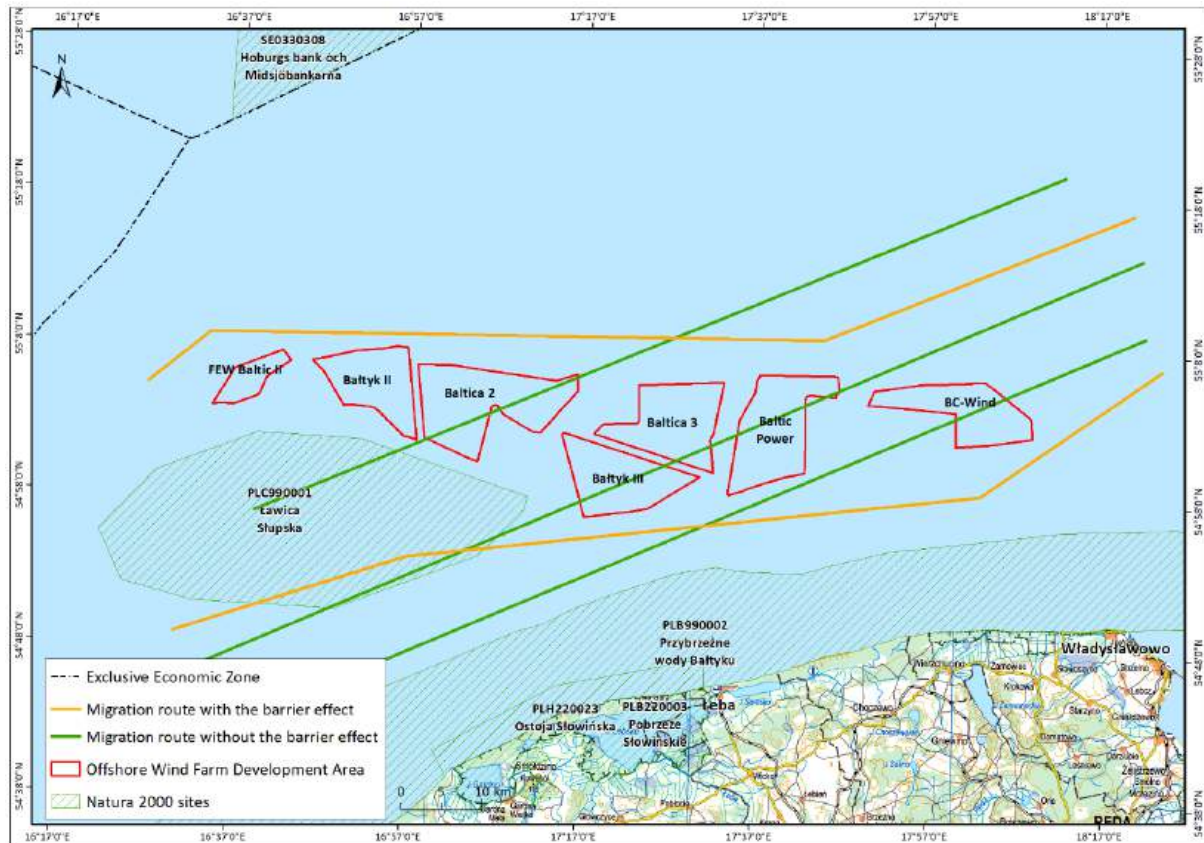


Figure 7.2. Examples of theoretical migration routes of birds migrating along the axis from the north-east to the south-west [Source: internal materials]

Due to a marginal increase in the energy expenditures related to the change in flight trajectory, for the majority of the species the significance of impact was assessed as negligible. Only for the long-tailed duck, the common scoter, and the velvet scoter it was assessed as low [Table 7.3]

Cumulative collision risk

To estimate the number of possible collisions in the case of cumulative impact the results obtained from collision risk modelling were multiplied by 16.25, a factor which takes into account the capacity of the remaining seven OWFs in relation to the BC-Wind OWF capacity. For most species, mortality still remains at a very low level. The cumulative impact in the case of the common scoter cannot be excluded (from a few to over a dozen individuals subject to collisions), and in the case of the crane it means a maximum of 227 individuals in autumn in the APV taking into account all clearance variants. Therefore, the significance of the cumulative impact for cranes was assessed as moderate. The good condition of this species' population, even at the maximum collision mortality rates, will not change. The low significance of the cumulative risk of collision was determined for the long-tailed duck, the common scoter and the velvet scoter [Table 7.3].

Table 7.3. Summary of cumulative impacts on migratory birds [Source: internal materials]

Species/group of species	Receptor value/significance	Impact	Impact reversibility	Size of impact	Significance of impact
Long-tailed duck <i>Clangula hyemalis</i>	High	Barrier effect	Reversible	Irrelevant	Low
		Risk of collision	Irreversible	Irrelevant	Low

Species/group of species	Receptor value/significance	Impact	Impact reversibility	Size of impact	Significance of impact
Common scoter <i>Melanitta nigra</i>	Moderate	Barrier effect	Reversible	Irrelevant	Low
		Risk of collision	Irreversible	Irrelevant	Low
Velvet scoter <i>Melanitta fusca</i>	High	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Low
Ducks (Eurasian wigeon, etc.) <i>Anatini</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Greater scaup <i>Aythya marila</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Geese <i>Anseridae</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Swans <i>Cygnidae</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Divers <i>Gaviidae</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Auks <i>Alcidae</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Great black cormorant <i>Phalacrocorax carbo</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Little gull <i>Hydrocoloeus minutus</i>	Moderate	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Black-headed gull <i>Larus ridibundus</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Lesser black-backed gull <i>Larus fuscus</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Common gull <i>Larus canus</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Terns <i>Sternidae</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Charadriiformes <i>Charadriiformes</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Common crane <i>Grus grus</i>	High	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Moderate
Passerines <i>Passeriformes</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible

The space disturbance created as a result of the OWF construction stems from the presence of a structure above the water surface, in the sea areas previously free from any physical barriers. The formal conditions indicated in the PSzW permit for the BC-Wind OWF, as well as the other OWFs, introduce restrictions concerning the possibility of their development. They indicate that the distances between individual wind turbines cannot be smaller than four times the length of the diameter of the

rotors. Therefore, the space disturbed is practically limited to the rotor working height range. Thus, within the BC-Wind OWF Area, as well as in the remaining OWF Areas, a partial, long-term (limited to the time of operation) limitation of the aerial space use shall take place. Within all of the OWF Development Areas (between individual wind turbines and the accompanying structures) as well as around the individual OWF Areas, the space shall remain undisturbed. The discontinuous nature of the development, with significant distances between individual OWF structures (of at least approx. 1000 m), shall 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.

The aerial space above the sea areas is used regularly by birds, including, especially, migratory birds. Their disturbance by a physical barrier creation shall result in the necessity to bypass it, both during the spring and autumn migrations.

Taking into account the investment plans related to wind energy in the central part of the Southern Baltic (the sea areas POM.43.E, POM.44.E, POM.45.E and POM.46.E from the Maritime Spatial Plan of Polish Sea Areas) and assuming that they will be implemented, it can be indicated that eventually an area with a length of about 130 km will be developed. For the birds flying in accordance with the prevailing directions of migration in this region, the actual width of the barrier will be approx. 90 km. Disruption of space at such a long fragment of the maritime area could lead to a significant disturbance in bird migration.

The development of this space shall not be uniform and shall depend on the location of the wind turbines on individual OWFs. The space between the Baltica 2 OWF and the Baltica 3 OWF shall remain free from development, in accordance with the DEC for the Baltica OWF [94]. This area shall enable migratory birds to fly to and from the Słupsk Bank site. It constitutes an actual division of a sequence of OWF Development Areas. A corridor with a width over 2 km between the Baltica 3 OWF and the Baltic Power OWF is also being designated [486].

The BC-Wind OWF constitutes the eastern boundary of the areas listed in the MSPPSA, bordering only from the west with the Baltic Power OWF. The zone free of development between the above-mentioned OWFs, allowing for the avifauna migration, has at least 4 km. This area shall create a system of space free from development, allowing for the movement of birds in a way minimising potential disruptions in their migration.

Without the full knowledge of the possible behaviour of birds in the context of such an extensive disturbance of the space used by them during the periods of migration, and taking into account the precautionary principle, the above-mentioned system of migratory corridors can be considered a solution beneficial from the point of view of birds using this area both during migration and for local movements.

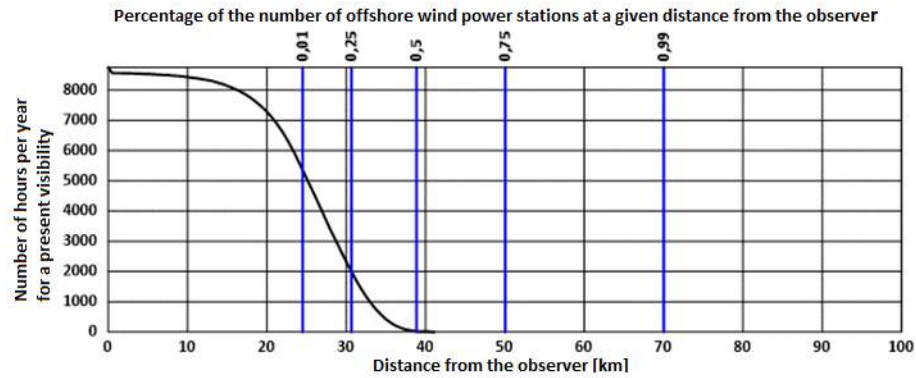
On the basis of the surveys conducted and with the application of the solution consisting in leaving the proposed areas (corridors) between the OWFs free from development, the significance of cumulative impact in the form of a physical barrier was assessed as low at maximum.

7.4.3.2 Landscape disturbances

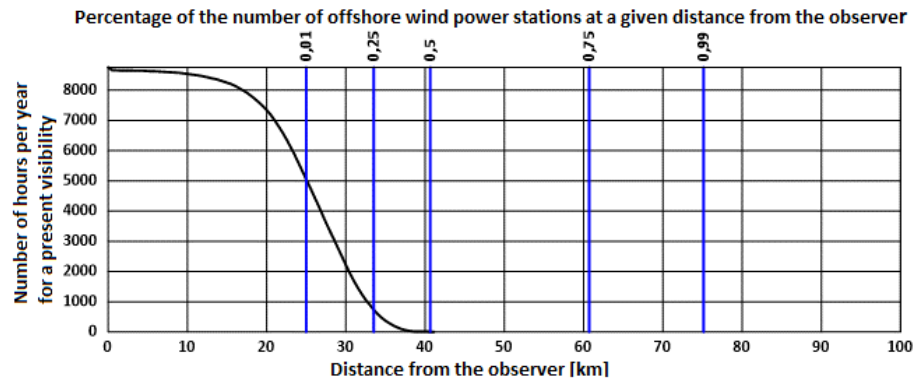
Landscape disturbances in the case of the cumulative impacts related to the simultaneous operation of the BC-Wind, Baltic Power, Baltica, Baltic II, Bałtyk II and Bałtyk III, as described in subsection 6.1.2.9, depend mostly on weather conditions i.e. visibility and the curvature of the Earth.

Figure 7.3 presents the number of hours per year for a given visibility (how often the visibility is greater than a specific value) based on the data from the atmospheric model UMPL (calculated by the ICM UW – data from approx. 5 years). These values are shown for 4 locations – Łeba, Lubiatowo, Dębki and Jastrzębia Góra. In the case of Łeba, single wind turbines may be visible even for approx. 5000 hours per year, but 50% of wind turbines installed in these OWFs may be visible for a very short period of time (several dozen hours per year). From Lubiatowo, single wind turbines may be visible for over 5000 hours per year, while 25% of the wind turbines installed in the OWF under assessment will not be visible practically at all. The observer from Dębki and Jastrzębia Góra may see single wind turbines for more than 5000 hours per year, but in practice they will never see more than 25% of the wind turbines installed.

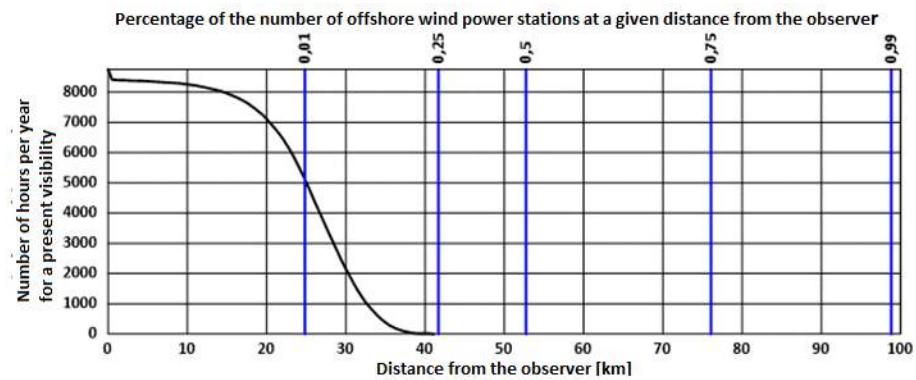
A)



B)



C)



D)

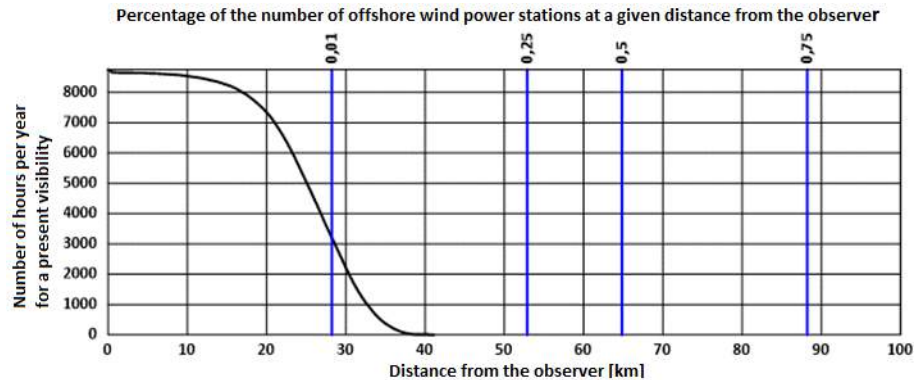


Figure 7.3. Number of hours per year for the preset visibility (distance from the observer) together with the distances of offshore wind turbines marked in the Applicant Proposed Variant in the option cumulated with the Baltic Power, Baltica, Baltic II, Bałtyk II and Bałtyk III OWFs (the total number of offshore wind turbines assumed and other large-size structures – 718). Graph A – Łeba, B – Lubiawo, C – Dębki, D – Jastrzębia Góra [Source: internal materials]

Additionally, the constraint associated with the visibility of wind turbines from land is the Earth curvature and the associated height restriction of the objects that can be seen from a great distance. In practical terms, this limitation manifests itself by the phenomenon that the further the offshore

wind turbines are located from the observer, the fewer of them can be seen. Photographs (Photo 7.1, Photo 7.2) present the visualisations of the view on BC-Wind OWF together with the Baltic Power, Baltica, Baltic II, Bałtyk II and Bałtyk III from Białogóra and Dębki.



Photo 7.1. Visualisation of the view on the BC-Wind OWF together with the Baltic Power, Baltica, Baltic II, Bałtyk II and Bałtyk III from Białogóra [Source: data from C-Wind Sp. z o.o.]



Photo 7.2. Visualisation of the view on the BC-Wind OWF together with the Baltic Power, Baltica, Baltic II, Bałtyk II and Bałtyk III from Dębki [Source: data from C-Wind Sp. z o.o.]

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 immune to the disturbance, but its value is not high, because very few people and only for a short time will be exposed to the change of landscape, and some of them (e.g. tourists) may perceive it as advantageous or interesting. The scale of the impact will have a large spatial extent, which will decrease with the increasing distance from the OWF. This will be a long-term but a reversible change. On land, the upper fragments of the OWF can be seen sporadically (Photo 7.1, Photo 7.2).

The visualisation of the BC-Wind OWF together with the Baltic Power, Baltica, Baltica II, Bałtyk II and Bałtyk III 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 functioning of systems using the electromagnetic field, such as: navigational radars of vessels, shore radar systems, radio communication devices and systems for transmitting radio and terrestrial television signals. The construction of a single OWF as well as more OWFs may disrupt the proper functioning of these systems. The magnitude of the disturbances would be directly proportional to the number of structures erected in sea areas and could cover a proportionately larger sea area.

Considering the possible negative effects of disturbances in the systems using electromagnetic field, the minister responsible for maritime economy obliged the Investors to perform a number of specific actions in the PSZW issued for all the OWFs. These activities will be aimed at ensuring the state defence and security as well as the safety of navigation.

The necessity to perform these compensatory actions indicates that the impact of the BC-Wind and other OWFs on the systems using electromagnetic field should be considered only as hypothetical and which in fact will not occur.

7.4.3.4 Fishery

The planned projects related to the implementation of the OWF and transmission infrastructure will be located within 13 statistical rectangles (K8, L8, M8, N8, O8, P8, L7, M7, N7, O7, P7, L6, O6 and L5), with their total area amounting to 1035.38 km².



Figure 7.4. Location of the OWF and the areas intended for the transmission infrastructure against the background of statistical rectangles [Source: internal materials]

In the statistical rectangles indicated, between 113 and 155 fishing vessels were operating to a greater or lesser extent in 2015–2019, representing between 14–19% of all the Polish fishing vessels [Table 7.4] actively operating in the Baltic Sea.

Table 7.4. Number of vessels fishing in the rectangles occupied by the OWF and transmission infrastructure as well as the total number of registered vessels in 2015–2019 [Source: internal calculations based on FMC data]

Year	Number of fishing vessels operating		Share of the number of vessels fishing in the statistical rectangles occupied by the OWF and the transmission infrastructure in relation to the number of vessels fishing in the Baltic Sea and registered in Poland [%]
	In the rectangles occupied by the OWF and transmission infrastructure	In the Baltic Sea, registered in Poland	
2015	155	810	19
2016	129	812	16

Year	Number of fishing vessels operating		Share of the number of vessels fishing in the statistical rectangles occupied by the OWF and the transmission infrastructure in relation to the number of vessels fishing in the Baltic Sea and registered in Poland [%]
	In the rectangles occupied by the OWF and transmission infrastructure	In the Baltic Sea, registered in Poland	
2017	115	797	14
2018	143	777	18
2019	113	786	14

The value of catches in the statistical rectangles where OWFs and transmission infrastructure will be located was between PLN 2.8 and 6.4 million in 2015–2019, the average value for this period being PLN 4.8 million [Table 7.5]. This represented between 1–3% of the value of Polish catches in the Baltic Sea. The volume of catches in individual statistical rectangles varied considerably. The highest average catch values in 2015–2019 were obtained in the P8 and L8 rectangles, amounting to PLN 950 thousand and 534 thousand, respectively. The areas of these statistical rectangles are to be occupied for the purposes of the OWF and the transmission infrastructure in 15.1% and 44.2% respectively. Estimated on the basis of the share of the areas to be occupied by OWFs together with transmission infrastructure in relation to their total area, the value of the catches conducted in 2015–2019 was on average PLN 960 thousand, varying from PLN 0.5 million in 2019 to PLN 1.2 million in 2015. This represented between 0.3 and 0.6% (on average 0.5%) of the value of the Polish catches in the Baltic Sea.

Table 7.5. Value of catches conducted in statistical rectangles (the entire area) in the area where the OWF is to be located [Source: internal calculations based on FMC data]

Statistical rectangle	Value of catches [PLN thousand]					Average value of catches in 2015–2019 [PLN thousand]
	2015	2016	2017	2018	2019	
K8	188.8	220.6	54.9	518.3	41.4	204.8
L5	773.2	842.5	410.5	286.6	317.5	526.1
L6	710.7	674.1	240.2	568	190.5	476.7
L7	460.1	362.6	246.5	449.3	171.2	337.9
L8	639.9	758.5	548.9	468.8	251.8	533.6
M7	403	509.9	312.8	369.5	147.9	348.6
M8	338.8	622.3	527.3	314.3	117	383.9
N7	308.4	240.7	271.1	226.3	93.9	228.1
N8	209.4	151.9	250	56.6	59.7	145.5
O6	461.6	223.2	151.3	217.1	64.8	223.6
O7	362.8	200.8	144.8	144.2	42.9	179.1
O8	382.9	119.4	374.5	160	79.3	223.2
P8	1138.8	361.6	1278.1	793.6	1207.4	955.9
Total	6378.4	5287.9	4810.8	4572.6	2785.1	4 767.00

In 2015–2019, in the area of the 13 rectangles under analysis, set gear accounted for the dominant share of the catch value (53% on average). Following the declining quantities of cod caught from year to year (due to the deteriorating stock condition), the share of set gear also decreased in terms of

value (from 54% and even 70% in 2015–2016 to 38% in 2019). The most important species caught throughout the period under analysis in terms of value was cod at 54%, followed by herring and flounder. In 2019, the share of cod in the value of catches decreased to only 23% in favour of an increase in the proportion of herring (up to 29%).

Table 7.6. Catch volumes in 2015–2019 in the area of the 13 statistical rectangles where the OWFs and transmission infrastructure will be located [Source: internal calculations based on FMC data]

Species/group	Catch volume by year [t]				
	2015	2016	2017	2018	2019
Cod <i>Gadus morhua</i>	907	802	426	433	125
Flounder <i>Platichthys flesus</i>	311	230	156	470	188
Herring <i>Clupea harengus</i>	981	270	979	365	670
European sprat <i>Sprattus sprattus</i>	168	172	103	486	639
Other	27	40	41	54	37
Total	2394	1514	1705	1808	1659

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. However, given the significantly reduced fishing potential of the Polish fleet after accession to the European Union and the aforementioned deterioration of cod stocks in the Southern Baltic, resulting in the suspension of targeted fishing for this species in the eastern Baltic Sea 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 Regulation (EU) 2019/124 as regards certain fishing opportunities in other waters (OJ L 281, 31.10.2019, p. 1–14)] as well as the extension of these restrictions to 2021, it should not be expected that excessive concentrations (above those recorded so far) of set nets after the shift of effort from the area occupied by OWFs will take place. With this in mind, the significance of the cumulative negative impact of the relocation of the fishing fleet can be considered of little importance.

Increased distance and time to fishing grounds

The creation of a barrier to the free passage of fishing vessels shall constitute a negative impact of the many OWFs presence in the neighbouring locations. The location of other OWFs east and west of the BC-Wind 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 incur additional costs, mainly for fishing vessels stationed in the ports of Ustka (59 vessels) and Łeba (30 vessels). This will be due to an increased amount of fuel necessary to navigate around the OWFs, and the time needed to reach the fishing grounds.

Figure 7.5 presents the location of the planned OWFs in relation to the shortest routes to the fishing grounds in the Słupsk Furrow area, along with the potentially changed routes to those fishing grounds due to the presence of the OWFs.

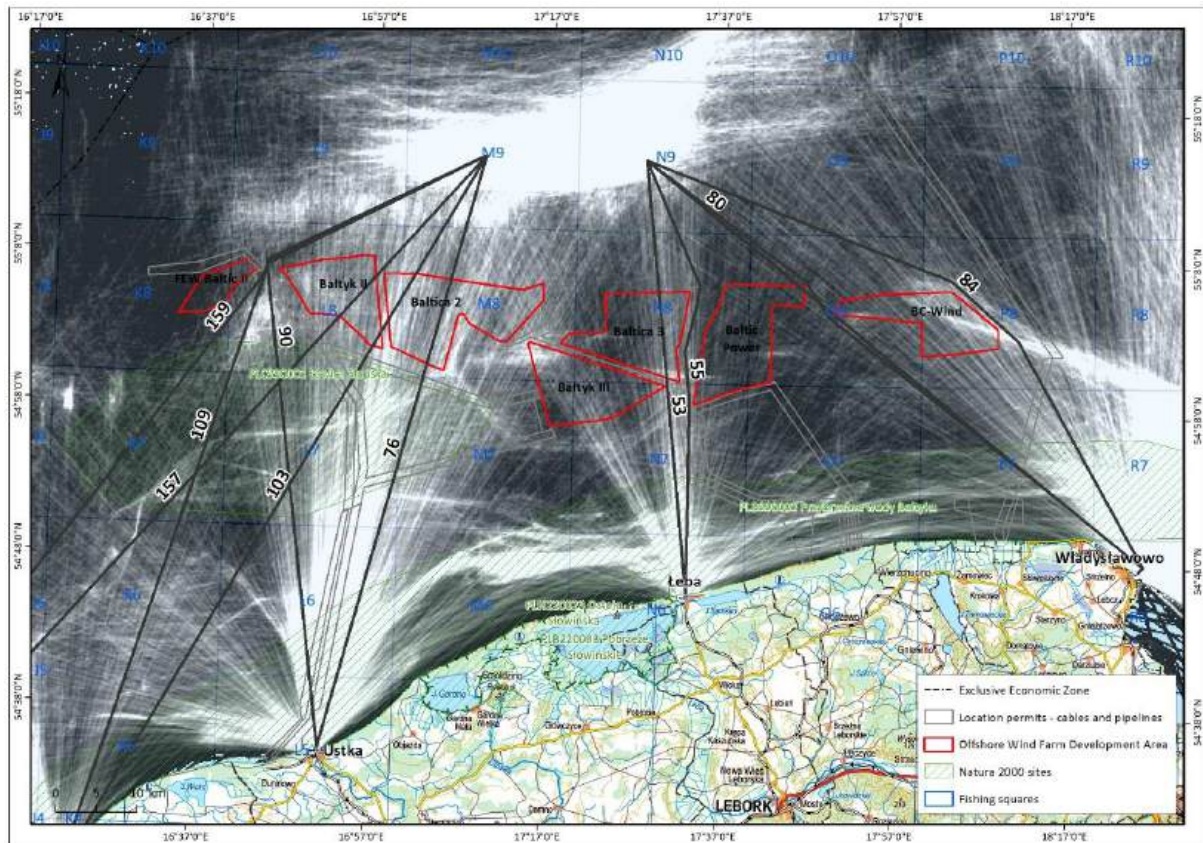


Figure 7.5. Existing and potentially extended routes to the fishing grounds in the Stupsk Furrow area, due to the presence of the OWFs [Source: internal materials]

In order to calculate the estimated increase in the costs of sea fishing activity, given the necessity to bypass the OWFs, a dedicated analysis was conducted regarding the activity of fishing vessels sailing from and returning to the ports in Kołobrzeg, Darłowo, Ustka, Łeba and Władysławowo. The calculations accounted for the number of cruises aimed at the fishing grounds located north of the OWFs. The centres of M9 and N9 statistical rectangles were selected as destination points for the purpose of the calculations. On the basis of the data from the logbooks and the register of fishing vessels, the number of fishing vessels operating in the statistical rectangles was determined: M9 for the ports in Kołobrzeg, Darłowo and Ustka, and N9 for the ports in Łeba and Władysławowo. Only the cruises beginning and ending in the same port were considered. In view of the above, the analysis accounted for fishing activities of vessels that usually pass through the OWF areas in order to fish in the Stupsk Furrow. On the basis of the RRW-19 Questionnaire – "Report on economic results of the fishing vessel," the average number of fishermen employed on board the vessels subject to the analysis was determined (in order to calculate the increase in labour costs). The average diesel consumption of 15 litres/hour was assumed in the calculation of the increase in fuel costs (approximate data, information from the owner of a K-15 KS vessel with a length of 17 m and engine power of 121 kW). The average fuel cost per kW of engine power was calculated using marine fuel prices in 2017–2019 (PLN 2047, 2505 and 2505 per tonne, respectively). The cost of additional work time of fishermen was calculated on the basis of average monthly salaries in the enterprise sector (PLN 4530, 4852, and 5169, respectively). The additional time required by fishing vessels to sail around the OWFs was calculated assuming the average speed of the vessel at a level of 6 knots (11 km/h). Table 7.7 provides information

on the extended time and length of the routes related to bypassing the OWFs, as required by fishing vessels to access the fishing grounds in the Słupsk Furrow area and return to home ports.

Table 7.7. Additional times and route distances required to bypass the OWFs on the way to and from the fishing grounds in the Słupsk Furrow area, calculated for the fishing vessels operating from the ports of Kołobrzeg, Darłowo, Ustka, Łeba and Władysławowo [Source: internal materials]

Port	Time [h]	Length [m]
Kołobrzeg	0.36	4
Darłowo	1.08	12
Ustka	2.52	28
Łeba	0.36	4
Władysławowo	0.72	8

The resulting calculations, based on the data from 2017–2019, indicate that the need for bypassing the OWFs by fishing vessels sailing from and returning to the ports in Kołobrzeg, Darłowo, Ustka, Łeba and Władysławowo, and fishing at the fishing grounds of the Słupsk Furrow will incur an increase in fuel costs by approx. PLN 40 thousand per year [Table 7.8]. The increased time of arrival to and return from the fishing grounds may generate additional labour costs of approx. PLN 111 thousand per year. Due to the significant importance of fishing grounds in the Słupsk Furrow area for the fishermen from the home port of Ustka, as well as the greatest extension of the route (by 28 km in both directions), the fishermen from that port will experience the largest increase in costs resulting from the need for bypassing the OWF area. The estimated total increase in fuel and labour costs for this port will approximate PLN 135 thousand, which constitutes approx. 90% of the total costs for all the ports under analysis [Table 7.8].

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Table 7.8. Calculation of additional costs for fisheries resulting from bypassing the OWFs en route to the fishing grounds of the Słupsk Furrow [Source: internal materials]

Year	Port	Number of vessels	Average crew number	Number of cruises	kW cruise	Additional cruise time [h]	Additional labour time [h]	Cost of 1 kWh [PLN]	Cost of 1 man-hour [PLN]	Additional fuel cost [PLN]	Additional labour cost [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

Given 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 regarded as high. In order to limit the negative impact on fisheries in this regard, navigation corridors should be preserved between the OWFs, with the necessary width ensuring the safety of navigation. In such a case, the significance of the project cumulative impact on fishery may be considered low. Another solution could be to allow the transit of fishing vessels through the BC-Wind OWF Area. The establishment of navigation corridors or the approval of navigation through the BC-Wind OWF Area is the sole responsibility of the director of the relevant Maritime Office.

8 Transboundary impact

The BC-Wind OWF Area is located in the Polish EEZ. The distances of this area to the boundaries of the EEZs of other countries are as follows:

- over 64.7 km from the Swedish Exclusive Economic Zone (EEZ);
- 90.5 km from the Danish EEZ;
- over 67 km from the Russian EEZ;
- over 208.2 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 BC-Wind OWF has been identified as regional in scale. This refers to the impact of:

- underwater noise on adult fish during the construction phase;
- underwater noise on marine mammals during the construction phase;
- barrier effect on birds during the operation phase.

Transboundary impacts are identified as occurring, when the range of impacts is international (extending beyond the Polish EEZ) and when physical damage to the hearing organ of marine mammals is possible (e.g. when PTS or TTS is involved). After the application of an NRS as a mitigation measure, none of the impact ranges for TTS and PTS of 1-hour cumulative SEL, extended to the international area [Figure 6.6–Figure 6.11].

With regard to the Convention on Environmental Impact Assessment in a Transboundary Context adopted in Espoo on 25 February 1991 and the Council Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment, potential transboundary impacts cannot be excluded for the BC-Wind 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 the birds that spend at least part of their lives in north-west Russia and Scandinavia. In addition, some of the species affected are listed in Annex I of the Birds Directive or included in the Natura 2000 programme of protected sites in neighbouring countries, and therefore, the impacts of the BC-Wind OWF may affect the abundance of birds which are the subject of protection in those areas.

Surveys carried out as part of the migratory bird inventory 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 irrelevant. The significance of the barrier effect at the level of a single OWF was assessed to be negligible for all species. Transboundary impacts were assessed likewise (in a few cases they were assessed as of low significance). For most species, the increased bird mortality due to collisions with OWFs, on a transboundary scale will constitute an undetectable part of the total mortality (natural and related to human activity). The moderate significance of the risk of collision in the case of the crane will not affect the condition of the populations nesting and wintering in the remaining Baltic countries (the mortality threshold for cranes, the biogeographic population of which can cope with and remain in good condition, is 1887 individuals per year [414]) and will be negligible or of low significance when mitigation measures are applied (periodic shutdown of individual wind turbines during the intensive passage 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 individuals as a result of the project impact.

In the case of a larger number of OWFs, with the application of recommended mitigation measures (also included in the EIA Reports for other OWFs in the area) it will be possible to avoid exceeding the mortality threshold mentioned above. It should be noted, however, that the effect will depend on the number of flying cranes, which, based on long-term observations of migration across the Baltic Sea, is characterized by a large variability, both in the number of individuals and in the location of migration.

In the context of all the OWFs in this area, an important element reducing the risk of collision is the creation of a system of corridors (areas free from development), enabling the free movement of birds between individual OWFs.

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, and in the summer period also of the common guillemot. The surveys conducted have indicated that the birds wintering in this part of the Baltic Sea travel locally in all directions with no distinct pattern during short feeding flights. This confirms the rule that seabirds have a strong attachment to their wintering grounds [190, 215, 320]. In the transboundary context, the results of the modelling of avifauna abundance at the BC-Wind OWF during the wintering period and the data from literature on their Baltic population size were compared and presented in Table 8.1.

Table 8.1. Comparison of the abundance of birds wintering in the OWF Area and the Baltic Sea area [Source: internal materials]

Species	BC-Wind OWF	Baltic Population
Long-tailed duck <i>Clangula hyemalis</i>	62	1 500 000*
Velvet scoter <i>Melanitta fusca</i>	3	373 000*
Razorbill <i>Alca torda</i>	288	155 000**
European herring gull <i>Larus argentatus</i>	631	no data
Total	984	-

*source: HELCOM 2013 [167]

**source: Chylarecki et al. [72]

no data – no data available

In comparison with the Baltic Population, the size of the long-tailed duck population in the OWF Area is 0.004%, the velvet scoter – 0.001%, and the razorbill – 0.2%. There is no data on the size of the Baltic population of the European herring gull. However, due to the fact that these birds accompany fishing boats at fishing grounds their occurrence in the open sea is strongly conditioned by human activity. Thus, no transboundary impacts of a single project consisting in the construction of the BC-Wind OWF are expected.

9 Analysis and comparison of the variants considered and the most beneficial variant for the environment

Issues related to the project variants, including descriptions and comparison of technical parameters of the two options analysed, 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 location decision issued (PSzW no. MFW/7/12 and MFW/4/13) as well as the applicable maritime spatial plan of Polish sea areas, it would be unjustified to include another place of the BC-Wind 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 capacity of the BC-Wind OWF, i.e. 500 MW, was adopted as the limit parameter in both variants considered. Therefore, with the use of higher power turbines, the construction of a smaller number of wind turbines becomes possible.

The RAV assumes 8 MW turbines for the purposes of the analyses. Taking into account the maximum installed capacity of the BC-Wind OWF, in this variant, it would be necessary to construct 62 wind turbines. With the turbine power output of 12 MW assumed in the APV, the maximum installed capacity will be achieved already after the construction of 41 wind turbines.

Construction and operation of a smaller number of wind turbines 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 hazardous lifting and offshore operations;
- lower consumption of construction materials and consumables.

Also, during the OWF operation phase, a smaller number of wind turbines 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 turbines 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 turbines 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 BC-Wind OWF in the 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 bird collisions with the wind turbine 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 operation phase is assumed), these differences are an important premise to indicate that the APV is a more environmentally beneficial 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 turbines and the rotor diameter. In consequence, they determine the size of the impact on individual elements of the environment.

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.

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 (Journal of Laws of 2001, No. 62, item 627, as amended), the technologies used in the 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 consumables and fuels;
- 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 catalogue of requirements refers to newly launched industrial installations and equipment that are the source of environmental hazards. Due to the process specificity of the construction, operation 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 substratum (seabed). The resistance to erosion, corrosion or chemical compounds activity that may occur in the water is a 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 energy 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 turbines 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 turbines and laying of submarine cables) and during the decommissioning of OWF elements after their technical wear. For 20–30 years of operation, wind turbines will require the use of consumable resources and fuels during servicing.

The emissions and their range will primarily concern the acoustic impact associated with the operation of wind turbines. They will not affect marine organisms significantly nor cause noticeable electromagnetic interactions.

Experiences related to the operation of wind turbines in the Baltic Sea allow the installation of the most efficient and proven solutions that meet the requirements of the most advanced technologies, resistant to the operating conditions of the marine environment at highly variable winds.

11 Description of the prospective actions to avoid, prevent and limit negative impacts on the environment

The environmental impact assessment carried out for the BC-Wind 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 BC-Wind 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 within a radius of 2 km from the piling site, the work may begin, preceded each time by the soft-start procedure [252, 363, 241];
- 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 BC-Wind OWF Area or one of them is in the area of another, neighbouring OWF;
- 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.

The mitigation measures proposed for the operation phase include:

- painting the blade tips bright colours, which should increase the likelihood of the operating wind turbine 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 turbine towers (not applicable to foundations or supporting structures), due to the greater probability of bird collisions with power stations of such structure (less visible to birds from a greater 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.

12 Proposal for the monitoring of the planned project impact and information on the available results of other monitoring, which may be important for establishing responsibilities in this area

Pursuant to the Art. 66 of the EIA Act a proposal to monitor the impact of the planned project in its construction and operation 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 Nature Conservation Act of 16 April 2004 (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 (from 2 to 3 years – up to 5 years), and the possibility of a staged introduction of particular parts of the OWF into operation, and hence, the overlapping of the construction and operation 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 BC-Wind OWF Area related to its construction;
- the beginning of operation – understood as the opening of the first stage of the BC-Wind OWF after which the energy generated at the BC-Wind OWF will be transferred to the NPS, a phase that may overlap with the ongoing construction works on the remaining parts of the BC-Wind OWF;
- the completion of construction – understood as the end of all construction works in the BC-Wind OWF Area and the moment when the project consisting in the construction of wind turbines in their full capacity begins to supply the NPS with the energy produced by all the power stations installed.

The monitoring surveys methodologies will be presented to the Regional Director of Environmental Protection to be agreed on before the beginning of the surveys.

12.1.1 Underwater noise monitoring

The acoustic field monitoring should be carried out in accordance with the guidelines for the OWF Environmental Impact Assessment specified in the German guidelines BSH 2011, 2013 [51, 61] (measurements of high-intensity noise generated during the construction phase, e.g. pile driving).

The measurements of noise related to the operation phase should include three operation ranges of wind turbines – “low”, “average” and “rated power” (in accordance with the various wind speed classes).

The above-mentioned German BSH guidelines have been developed by a group of experts and are adjusted to the Environmental Impact Assessment of an OWF. Thus, they are also suitable for use as part of the BC-Wind OWF assessment.

Monitoring during the construction phase

The details on the measurements of noise levels during the construction phase are presented in the document BSH 2011 [51]. In this report, the key parameters of the measurement campaign will be summarised. Hydrophone measurements should take place in the frequency range from 10 Hz to 20 kHz. The locations of survey stations should be designated at a certain distance from the location of the pile driver: BSH recommends a distance of 750 and 5000 m from the foundation and in the nearest protected area (if it is located further than 5000 m from the project area). Moreover, Skjellerup *et al.* [411] recommend:

- the use of calibrated omni-directional hydrophones with a sensitivity deviation of less than ± 2 dB up to 40 kHz in the horizontal plane and less than ± 3 dB up to 40 kHz in the vertical plane and the registration of the calibration signal;
- recording in the .wav format with the sampling frequency of 44.1 Hz and a 16-bit resolution;
- determination of SEL for each pile driver strike;
- conducting monitoring at two different depths, at 66 and 33% of the water depth (but always more than 2 m below the sea surface).

Monitoring during the operation phase

The monitoring of the background noise level during the operation phase is necessary to confirm the predictions contained in the EIA.

The data from the measurements conducted at individual turbines of the OWF should be collected at random. The sound measurement should be conducted at a distance of approx. 100 m from the source of sound and the central area of the OWF.

Additionally, the measurements should be conducted outside the OWF Area at a distance of 1000 m and in the area of the nearest protected area, under the condition that this area is located at a distance not exceeding 5 km from the OWF Area. If there is no protected area in the vicinity, sound measurements should be conducted at a distance of 5 km from the OWF Area.

Monitoring duration

During the construction phase, the measurements of the underwater noise level should be conducted during pile driving at specified time intervals, however, their exact timing depends on the agreement made with the regulatory authority and whether the sound exposure criteria have been established. The monitoring should cover a representative set of pile driving locations (e.g. at least 10% of all pile driving locations) and should be conducted throughout the entire construction phase [411]. During the operation phase, the measurements should be conducted for each of the wind speed classes corresponding to Beaufort scale 2, 4 and 6.

12.1.2 Ichthyofauna monitoring

The monitoring of ichthyofauna will be carried out during the OWF operation and after its decommissioning.

During operation, 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 BC-Wind 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, human pressure (commercial and recreational fishing).

The detailed methodology of the post-investment monitoring will be possible to develop 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, 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 period, 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) enabling the identification of not only the direction of flight and reaction, but also of the species. A survey station should be located on a permanent platform (OWF substation) 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 in time during the migration season. Taking into account the experiences from similar projects in the Baltic Sea and the North Sea areas [i.a. 25, 91, 153], the authors of the report propose that the monitoring of migratory birds is conducted in two cycles per year, resulting from the 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 operation (due to the possibility of the continuation of construction for more than 4 years from the beginning of operation 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 Monitoring of seabirds

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 BC-Wind 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 MSPPSA. 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 transects in the BC-Wind 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.

Operation phase

The 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 2 cruises per month). In the remaining months, the abundance of birds in the BC-Wind OWF Area is low, therefore, in the summer period it is enough to carry out 2 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 BC-Wind 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 Monitoring of marine mammals

Due to small density of the harbour porpoise in the survey area, acoustic monitoring of the harbour porpoise is very difficult. However, further monitoring of the harbour porpoise in the survey area using the C-POD devices or similar is suggested. Apart from that, it is suggested to resign from aerial surveys, because during the flights conducted so far, no marine mammals have been observed.

Monitoring during the construction phase

In the area of the planned OWF, at least 5 C-PODs should be located, preferably in the same locations as during the environmental monitoring. In addition, 5 C-POD devices should be installed in a gradient system covering an area of not less than 20 km outside the impact zone (for the range of behavioural reactions to piling, an example provided in Brandt *et al.* [53]). The gradient system requires the classification of samples according to the distance and excludes 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 shown to be more effective in studying the movement of the harbour porpoise in response to the piling process and in examining how temporary impacts vary with the change in distance [88]. Precise placing of these stations in the gradient system requires the indication of a detailed range.

Monitoring during the exploitation phase

The harbour porpoise monitoring in the exploitation phase should be conducted for 24 months using the same methods that were used during the construction phase.

Monitoring duration

The harbour porpoise monitoring should take place not later than 6 months before the planned construction, during the construction phase and at least one year after its completion.

12.1.6 Benthic organisms monitoring

In connection with the occurrence of negative impacts on the benthic complexes, monitoring of these organisms should be carried out, as the OWF construction will influence the local changes in the seabed biocenosis structure. During the construction phase, the primary impact will be the disturbance of the seabed sediment structure and physical destruction of invertebrates, while during the exploitation phase, the primary impact will be the loss of a fragment of macrozoobenthos habitat and the “artificial reef” effect the significance of which in the PMA is unclear at present. Therefore, the purpose of the proposed monitoring is the determination of the scale, spatial and time range of those factors, all the more because no OWF is operational yet within the PMA and the actual intensity of the impacts caused by such project in this part of the Baltic Sea is not supported by the knowledge gained during the post-implementation monitoring. 12 OWFs are planned to be constructed by 2040 in the Polish part of the open waters of the Southern Baltic [346]. An important aspect of the monitoring of benthic organisms is also to organise the hitherto random knowledge on the colonisation of artificial hard bottom substrates by animal and plant periphyton complexes in the PMA [subsections 6.1.2.6.1.1 and 6.1.2.6.1.2]. An important strategy of monitoring surveys is the possibility to compare them with the data obtained during the inventory surveys. For this reason, the planned monitoring should cover the seasons similar to the inventory surveys seasons. Due to the lack of standard, commonly used

guidelines for the implementation of this type of surveys in the PMA, an original monitoring methodology has been proposed, based primarily on the life cycle of benthic organisms in the Southern Baltic. The benthos monitoring proposal developed herein was also based on the literature of the subject [76, 96, 61]. The macrozoobenthos surveys should be carried out in accordance with standard methodologies [162], and the periphytic flora and fauna surveys, in accordance with the methodology of Kruk-Dowgiałło *et al.* [231]. The proposed scope of methodologies for benthic organisms is presented in Table 12.1.

Table 12.1. Programme of benthos monitoring surveys in the BC-Wind OWF Area [Source: internal materials]

Period	Parameter	Methodology
During the first year after the installation of wind turbine foundations	Macrozoobenthos	Surveys of macrozoobenthos complexes (soft bottom – with a van Veen grab sampler, hard bottom – with an ROV) in the area of 5 foundations/supporting structures of wind turbines. In the vicinity of a single foundation/ 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, and 3 stations along the transect perpendicular to the main profile (reference profile) at the same distances. Additionally, 5 stations should be located in the central point (outside the cable route) between four adjacent foundations/supporting structures of which one will be covered by the above-mentioned monitoring along two profiles. 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)
Second year after the installation of wind turbine foundations	Periphytic fauna and flora	The survey of periphytic fauna and flora will be carried out on 5 underwater structural components of wind turbines. At each object surveyed, a video (or photographic) documentation of the entire section covered with macroalgae and periphytic fauna will be made (note: the depth of periphytic flora occurrence may differ from the range of periphytic fauna occurrence). Beginning from the water surface to the depth of the maximum range established for the periphyton 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 periphytic flora and fauna. The surveys will be carried out once a year in June
Third year after the installation of wind turbine foundations	Macrozoobenthos	Continuation of the survey from the first year on the same stations during the restoration and formation of the originally damaged macrozoobenthos complex
Fourth year after the installation of wind turbine foundations	Periphytic fauna and flora	Continuation of the survey from the second year on the same stations during the formation of a new periphytic fauna and flora complex
Fifth year after the installation of wind turbine foundations	Macrozoobenthos	Continuation of the survey from the first year on the same stations during the restoration and formation of the originally damaged macrozoobenthos complex
Sixth year after the installation of wind turbine foundations	Periphytic fauna and flora	Continuation of the survey from the second year on the same stations during the formation of a new periphytic fauna and flora complex

12.1.7 Monitoring of bats

The purpose of post-implementation monitoring is to verify the assessment assumptions in terms of changes in the use of the BC-Wind OWF 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 [344].

Post-implementation monitoring should cover the period of 3 years, in the first year after the wind turbine has been 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 [210, 211].

12.2 Information on the results available for other monitoring, which may be important for establishing responsibilities in this area

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 (harbor 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 [328]:

- the Flagship Bird Species Survey, covering the monitoring of 12 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 Fisheries Monitoring Centre collects data on the volume of fish catches carried out in the 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 BC-Wind 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 covers 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.

In the Baltic Sea area, several monitoring programmes concerning marine mammals have been conducted. Probably the most comprehensive surveys of the Baltic population of the harbour porpoise have been carried out as part of the SAMBAH project, during which the data on the harbour porpoise echolocation frequencies at 304 C-POD stations located in the Baltic Sea and the adjacent waters were collected from May 2011 to April 2013 [398].

The SAMBAH project methodology was also used in the monitoring of the harbour porpoise status in the Polish Maritime Areas by CIEP in Poland as part of the project "Pilot implementation of species and marine habitats monitoring in 2015–2018" [262]. The monitoring campaign covered two areas that were located in the areas of the Pomeranian Bay and the Stilo Bank. Additionally, the current information on the marine mammals observations at Polish coast are collected by WWF and the Hel Marine Station IO UG [515].

What is more, for all planned OWFs marine mammals monitoring is conducted. This constitutes a supplementary source of information to the SAMBAH and CIEP projects. Access to the results of those surveys would enrich the knowledge on the topic of seasonal occurrence of these animals within the Polish Exclusive Economic Zone over a longer period of time.

13 Limited use area

The issue of the creation of a limited use area (LUA) is regulated by the provisions of Art. 135 paragraph 1 of the Environmental Protection Law: *„If from the ecological review or from the project environmental impact assessment required by the provisions 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 assessment or from the post-implementation analysis, it appears that despite the use of the available technical, technological and organisational solutions, environmental quality standards cannot be observed outside the factory or other facility for wastewater treatment plants, landfill sites, composting sites, communication route, airport, overhead power line and power substation as well as radiocommunication, radionavigation and radiolocation installations, an area of limited use is created”*.

From among the above-mentioned tasks, one prepared for implementation within the planned project, i.e. a power substation may require the creation of an LUA.

The reasonableness of establishing an LUA with reference to the planned OWF should be considered by analysing whether the environmental quality standards outside the planned OWF cannot be met, as understood for a plant within the meaning of Article 3(48) of the Environmental Protection Act: *“plant – is understood as a single or many installations including the premises, to which the operator has the legal title, as well as the equipment situated thereat”*.

This EIA Report indicates that at the current stage of the 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 approx. 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 BC-Wind 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/7/12 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 200 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 200 MW together with technical, research and measurement, and service infrastructure related to the preparatory, construction and exploitation stages”];
- the Applicant submitted a request for issuing the PSzW and obtained the Decision of the Minister of Transport, Construction and Maritime Economy no. MFW/4/13 of 06 February 2013 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 200 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 200 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 were adopted:
 - “Polish Energy Policy until 2030” adopted by the Resolution of the Council of Ministers no. 201/2009 of 10 November 2009,
 - “Maritime Policy of the Republic of Poland until 2020 (with forecasts until 2030)” (Ministry of Infrastructure, Warsaw 2015) elaborated by the Inter-Ministerial Maritime Policy Team of the Republic of Poland on the basis of the document “Guidelines on Maritime Policy of the Republic of Poland until 2020” of 14 September 2009,
 - 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 “Maritime Spatial Plan of Polish Sea Areas”. The planning process includes the development of: “the Study of Conditions for the Plan and the Maritime Spatial Plan of Polish Sea Areas; in 2015, the preparation of the Maritime Spatial Plan of Polish Sea Areas together with spatial analyses”. The draft plan was prepared in 2019 and was implemented in 2021,
 - “2020 Pomorskie Voivodeship Development Strategy” adopted by the Resolution no. 458/XXII/12 of the Regional Council of the Pomeranian Voivodeship 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 Voivodeship of 8 August 2013;
 - “Plan zagospodarowania przestrzennego województwa pomorskiego 2030” [literally: Pomeranian Voivodeship 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.

- The Maritime Spatial Plan for internal sea waters, territorial sea and the Exclusive Economic Zone, 1:200 000 scale, was adopted by the Regulation of the Council of Ministers of 14 April 2021 (Journal of Laws of 2021, item 935).

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 the 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, opposite Łeba-Władysławowo towns, at a distance of approx. 22.6 to 31 km from the shore. The nearest seaports are Łeba and Władysławowo in the Pomeranian Voivodeship. 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. Given the nature of the OWF, it has been considered probable that it could affect fisheries and navigation within and around the OWF.

The following aspects related to the planned OWF have been identified as the ones that may cause social conflicts:

- construction and transport of large-size offshore structures;
- concern for the state of the environment 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 about the impact on tourism in coastal municipalities;
- concerns about 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 associations and organisations;
- non-governmental environmental organisations;
- potential suppliers, partners, other offshore investors;
- 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 an information meeting with the representatives of fishermen organisations. As part of this Report, on 8 June 2021 an information meeting was held with the representatives of fishermen organisations in Władysławowo, for which presentations and information materials were prepared. Formal consultations will be carried out as part of the environmental impact assessment procedure conducted by the Regional Director for Environmental Protection in Gdańsk.

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.

From the information meeting held in 2021, it emerged that the main concern of the fishermen is the occupation of the fisheries by the OWF Area, the transit across the OWF Area and the method of using the OWF Area for fishing and transit of fishing boats to the fisheries located north of the OWF Area as well as extension of the routes to such fisheries. The Applicant has confirmed at the meeting that they do not intend to apply for additional restrictions beyond the ones established by the maritime administration.

The comments and requests of the stakeholders made during the information meeting 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

The results of previous macrozoobenthos surveys within the survey area, i.e. the area of the planned BC-Wind OWF project, have not been published in the scientific literature yet. It is, therefore, impossible to determine the nature and direction of changes in the taxonomic and quantitative structure of macrozoobenthos communities that occurred in this area over the years.

A potential impact on the macrozoobenthos that will be present during the construction of the BC-WIND OWF is the emission of underwater noise. The harmful effect of this impact on the physical, physiological and behavioural response of invertebrates, especially those in the Baltic Sea, is still insufficiently identified. The research conducted so far primarily in laboratory conditions on selected crustacean and bivalve species from the North Sea or the Atlantic Ocean have shown that noise may lead to various negative changes in the functioning of benthic organisms but have not provided an answer to the question of what level of anthropogenic noise has stress-inducing impact on the macrozoobenthos [243, 62, 419, 369, 163, 493]. The available literature on the impact of piling works causing harmful noise indicates that it is a factor of low impact scale on the benthic fauna of the Baltic Sea [29]. However, more detailed data with regard to specific macrozoobenthic species is unavailable, especially those that play a significant role in the ecosystem and for which it is impossible to determine the sensitivity towards the impact described.

Also, the impact of heat emission by the cables connecting the wind turbines during the OWF exploitation phase is poorly documented in literature. This factor is unlikely to adversely affect the survival of macrozoobenthos as, in principle, the benthic fauna is naturally adapted to considerable seasonal changes of temperature [516, 33].

The last impact about which the existing information in the literature of potential influence on the Baltic Sea benthic fauna is becoming increasingly well-documented, yet still equivocal, is the magnetic radiation transmitted by power cables during an OWF exploitation phase [277, 516]. The important preliminary information is specifying the depth of cable laying, its size as well as the exposure time and cable type (AC or DC) [12, 326], and at the current stage of preparing documentation for this project concerning the technical concept, there are no detailed relevant data available. The impact of electromagnetic field on individual species of benthic fauna, including bivalves, crustaceans or polychaetes, has so far been examined only on the basis of laboratory tests [39, 191, 327, 423], and their results vary depending on the input data of the electromagnetic field emitted and the organisms examined. The results of an experiment conducted on the benthic fauna species which are representative and important in the PMA, i.e. *Limecola balthica* mussels and *Hediste diversicolor*

polychaete suggest negative, cytotoxic and genotoxic impact of an electromagnetic field with frequency of 50 Hz and magnetic induction of 1 mT on these organisms, leading to cancer. The authors of this experiment [423] recommend to consider the *L. balthica* mussels as bioindicator species for the electromagnetic field impact on the benthic fauna. Also, in accordance with the Marine Strategy Framework Directive (MSFD; Directive No. 2008/56/EC) it is recommended to investigate the impact of electromagnetic field on aquatic organisms to determine the minimum value of harmful influence of this parameter on individual groups of animals. Summing up, the electromagnetic field may have a non-significant, negative impact on benthic species at the level of biochemical and physiological changes [39, 29, 327], but it is still difficult to determine whether the size of the electromagnetic field emitted by AC or DC cables will cause any undesirable impact on macrozoobenthos in the BC-Wind OWF Area.

The assessment of the impact on the macrozoobenthos carried out for the OWF decommissioning phase should also be considered. Since currently there is lack of experience in the decommissioning process of OWFs in Europe, which will begin on a larger scale only in the next decade [452, 453] as well as a lack of technical assumptions for this project in terms of the OWF decommissioning, it should be underlined that this assessment is conducted on the basis of the best knowledge available to date, however, it cannot be excluded that these are only the predicted consequences for the macrozoobenthos.

Ichthyofauna

Literature on the subject of impacts related to the construction and exploitation of an 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 were found. So far, there has been no documented ichthyofauna monitoring during an OWF structure 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.

No ichthyoplankton surveys had been carried out in the BC-Wind OWF Area before. The only source of information to which the results obtained can be referred to are the data collected during the one-year long ichthyofauna monitoring conducted within the areas located in the vicinity of the planned OWFs. The scarce amount of data for the shallower areas of the Southern Baltic results from the fact that this area is located outside the network of survey stations at which the NMFRI conducts standard plankton surveys. The network is designed in such a way as to cover the spawning grounds for most of the commercially caught fish species, excluding shallower sea areas. In the case of non-commercial species with early development stages present in both the deep water and the shallow coastal areas, the available information is scarce and often distant in time and does not relate strictly to the area surveyed.

There is some information on spatial distribution of ichthyoplankton in the coastal zone of the Baltic Sea of up to 40 m in depth. However, because these surveys are conducted randomly, often only once,

at stations in different areas, the data acquired is limited. Some of them refer to single stations along the Polish coast, while others are concentrated in the Gulf of Gdańsk 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 BC-Wind 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

The main limitation concerning the collection of data on marine mammals are the logistic challenges during data collection at sea. In consequence, this results in gaps in the knowledge on the seasonal occurrence of these animals in the Baltic Sea area over a longer period of time.

As a result of the monitoring conducted, it has been concluded that marine mammals occur sparsely in the BC-Wind OWF Area. In this respect, the results obtained correspond to the results obtained as part of the projects SAMBAH and “Pilot implementation of species and marine habitats monitoring in 2015–2018” (CIEP) [398, 262]. It should also be underlined that the confidence interval (CI) of the results of surveys conducted as part of the SAMBAH project is very high. The estimates on the abundance of marine mammals are characterised by high statistical variability [449]. As a result, the Environmental Impact Assessment is difficult. Moreover, the surveys conducted for the OWF purposes do not provide very precise information on the abundance of marine mammals in the survey area due to their small spatial and temporal ranges as well as low density of marine mammals in the Southern Baltic.

The noise exposure criteria are also a source of uncertainty. The criteria published by NMFS [301] are a step forward, because they include the frequency-dependent audibility of marine mammals in a more comprehensive way than it was possible before. However, the hearing thresholds and the weighting functions are derived from few studies and are based on the noise sources of slightly different spectral and temporal properties than the ones studied in the BC-Wind OWF project, thus, the animals’ reactions may be different. Nevertheless, these are currently the most up-to-date criteria and have therefore been used in this assessment. The knowledge on the impact of noise on marine mammals is continuously being extended. The impact ranges calculated should, therefore, be treated with caution.

Additionally, C-POD devices which are generally acceptable and commonly used tools in the harbour porpoise monitoring [88], have a limited detection range (similar to other hydrophones), which may condition the detection of harbour porpoises in the survey area [134, 445]. This is particularly significant in areas with low densities of these marine mammals.

Migratory birds

The knowledge on nocturnal migrants is currently insufficient to accurately determine their species composition and to answer the question of at what altitudes exactly individual species fly. This concerns especially the species that are not vocally active. So far, there is no technology available that would enable identifying these species. The only data collected for the nocturnal migrants in the central part of the Baltic Sea concerned the areas of the Bałtyk II and Bałtyk III OWFs, the Baltica 2, Baltica 3 and the Baltic Power OWFs [25, 153, 154]. Despite the lack of reports regarding nocturnal

migrants, the data collected for the BC-Wind OWF are sufficient to draw conclusions for the purposes of the environmental impact assessment for this OWF.

In the case of the Polish coastal waters, apart from environmental surveys for the Bałtyk II and Bałtyk III OWFs as well as the Baltica 2, Baltica 3 and the Baltic Power OWFs, the surveys carried out in the BC-Wind OWF Area constitute the only complete study on migratory birds in the survey location during the spring and autumn migrations. The results obtained for the Dębki-Białogóra OWF Area (planned project) are available, however, the surveys were limited to visual observations only and did not include both migration seasons (autumn observations began in October). Also, the surveys were focused only on waterbirds [64]. Nevertheless, the monitoring carried out for the investment related to the construction of the BC-Wind OWF covers all types of surveys considered the best practice for the purpose of preparing an environmental impact assessment.

Seabirds

The current knowledge on the occurrence of seabirds in the Baltic Sea is based primarily on the surveys conducted in the winter [105, 407]. In the Polish zone of the Baltic Sea, the surveys conducted in the remaining phenological periods were carried out as part of the pre-investment monitoring (the planned offshore wind farms Dębki-Białogóra, Bałtyk Północny, Bałtyk II, Bałtyk III, and Baltica) or as part of the development of the plans for the protection of the Natura 2000 marine areas (“Zatoka Pomorska” and “Przybrzeżne wody Bałtyku”). Also, the lack of data on birds staying at sea within the Polish EEZ outside the above-mentioned areas constitutes a major hindrance in the interpretation of the results obtained. The exemplary detection of large, previously unknown, concentrations of the common guillemot in the OWF Area demonstrates that our knowledge on birds outside the 12-mile strip of territorial waters is still incomplete.

It is also unknown whether seabirds spend entire winter in one sea area, or whether they move from one part of the Baltic Sea to another. It is very probable that they move over small distances in reaction to changes in the abundance of food [282]. However, there are still no reliable data on the displacement of seabirds within the Baltic Sea (including the most abundant species of sea ducks) from one wintering ground to other, distant places of wintering.

At the current stage of our knowledge on the seabirds gathering within the Baltic Sea area, away from the coasts, the interconnections between the Natura 2000 network sites cannot be fully assessed.

In relation to the estimation of the collision probability, there is a serious lack of knowledge about the behavioural avoidance response to wind turbines by birds, affecting basically all species. Due to this deficit of knowledge, the risk of collision is often assessed taking into consideration the precautionary principle, and therefore, the number of potential collisions may be, on the one hand, overestimated, and on the other hand, underestimated.

At the moment, it is not known whether the bird species considered sensitive to the presence of the OWF (e.g. divers, long-tailed duck, velvet scoter) shall adjust (and if yes, to what extent) to its presence and begin to use its area once again.

The period covered by surveys was divided into four phenological periods. This division is arbitrary to a large extent, since various species migrate at slightly different times, and thus, the autumn migration of common scoters is observed as early as in August, while long-tailed ducks begin their autumn crossing at the end of September [281]. As shown by the results obtained in these surveys, the spring migration period of sea ducks ends in April, thus, for these species May should be considered rather

as a summer period. The division into four phenological phases adopted here enables the grouping of observations into periods in which the majority of waterbird species the presence of which can influence decisions related to the project, migrates, is wintering or stays in the coastal area.

It should be noted that the results of the visual observations of migrating birds conducted during survey cruises may constitute only an auxiliary material in the analysis of data obtained in the course of surveys with the use of radars directed at birds flying above the OWF Area. Vast majority of passerine birds cross the Baltic Sea at night, hence the registration of their flights with the use of radars is necessary to study the directions, flight altitude limits and the intensity of the migrations. Observations conducted by day are primarily related to individuals, which did not adopt a typical scheme of behaviour, and so their flight over the sea does not necessarily have to be conducted the same way as at night. Moreover, the visual assessment of a flight altitude is certainly vitiated by a large error resulting from, among others, the position of an observer in relation to a flying bird, the movement of the ship deck resulting from the wave motion and the distance to the bird observed, as well as individual predispositions to assess the distance correctly. Additionally, birds, especially the ones belonging to the species of small sizes, are difficult to notice when they are flying at significant heights. This is why their number may be considerably underestimated. Therefore, the survey methodology applied does not offer a full picture of bird movements, and only supports the results acquired with the use of radars.

In this Report, the European herring gull is treated as a species *sensu lato*, i.e. a taxon including three species differentiated nowadays but very similar: the European herring gull *Larus argentatus* – *sensu stricto*, the Caspian gull *Larus cachinnans* and the yellow-legged gull *Larus michahellis*. The surveys conducted in the northern Poland indicate that the species that clearly predominates among the three is the European herring gull, and the two others appear there rarely [278, 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 turbines on bats”] prepared by Polish specialists and practitioners for the General Directorate for Environmental Protection in 2011 [210]. 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.

Raw materials and paleolandscape

Since the Applicant plans to conduct core sampling of the seabed, at this stage, the presence of seabed sediments, which constitute resources of aggregate minerals or may indicate the occurrence of Paleogene settlements cannot be confirmed or excluded.

16 Summary of the information on the project

The planned project consisting in the construction, exploitation and decommissioning of the BC-Wind OWF is located in the Polish Baltic Sea EEZ, north of Dębki, at a distance of over 22.6 km north of the shoreline.

The planned project covers an area specified in the decisions PSzW no. MFW/7/12 and PSzW no. MFW/4/13 obtained by the Applicant, including a part of sea area 46.E from the Maritime Spatial Plan of Polish Sea Areas adjacent in the north-east, and limited by 2 nautical miles from sea area 54.T. From the west, the Development Area is limited to a distance of 4 km from the Baltic Power farm located in the vicinity of the BC-Wind OWF. The total area of the sea area intended for the BC-Wind OWF facilities and installations is 86.28 km².

The planned project can be implemented in stages.

Offshore wind turbines, offshore substations, electricity grid and telecommunication network together with infrastructure conditioning the correct operation of the BC-Wind OWF will be installed on the seabed at variable depths – within the range from 30.0 to 62 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 BC-Wind OWF from the offshore substations to the 400 kV Choczewo Station.

A compilation of the most important parameters of the BC-Wind OWF is presented in Table 16.1.

Table 16.1. Compilation of the most important parameters of the BC-Wind OWF for the Applicant Proposed Variant [Source: internal materials]

Parameter	Applicant Proposed Variant
Installed power [MW] (maximum)	500
Maximum number of wind turbines [pcs.] (maximum)	41
Wind turbine power output [MW] (minimum)	12
Rotor diameter [m] (maximum)	280
Clearance between the rotor operation area and the water surface [m] (minimum)	20
Wind turbine height [MASL] (maximum)	330
Number of additional structures	6
Diameter of Gravity Based Structure [m] (maximum)	60
Seabed surface occupied by Gravity Based Structure [m ²] (maximum)	2826
Seabed surface occupied by foundations [m ²] (maximum)	115 866
Maximum length of cable routes within the internal wiring of the OWF (maximum) [km]	188

The BC-Wind OWF concept is based on assumptions adopted at initial stages of preliminary design work. Therefore, the technical parameters and their limit values for the BC-Wind 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 turbines and their arrangement within the BC-Wind 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 of 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, research and measurement platforms as well as accommodation and service platforms.

It is assumed that different types of wind turbines with different capacity and on different types of foundations or support structures will be used.

The BC-Wind OWF operation cycle covers the following phases:

- construction and manufacturing works at onshore facilities;
- construction of a wind farm in the offshore area;
- period of simultaneous construction and exploitation of subsequent stages of the BC-Wind OWF connected to the NPS in the case of implementing the project in stages;
- BC-Wind OWF exploitation period;
- gradual decommissioning of the BC-Wind 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 turbine installation on the western side of the BC-Wind 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 research and measurement platforms.

During construction works related to foundation piling, an 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 placed 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 – $SEL_{cum} 186 \text{ dB re } 1 \mu\text{Pa}^2\text{s}$, for porpoises – $SEL_{cum} 140 \text{ dB re } 1 \mu\text{Pa}^2\text{s}$ weighted with HF function [301] and for seals – $SEL_{cum} 170 \text{ dB re } 1 \mu\text{Pa}^2\text{s}$ weighted with PW function [301].

Table 16.2 presents the assessment results of the impact that the planned project will have on the 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: internal materials]

Receptor	Significance of the BC-WIND OWF impact			
	Construction phase	Operation phase	Overlapping of the construction and operation phases	Decommissioning phase
Seabed	Negligible	Negligible	Negligible	Negligible
Wave motion and sea currents	None	Negligible	Negligible	No section
Seawater	Negligible	Negligible	Negligible	Negligible
Seabed sediments	Negligible	Negligible	Negligible	Low
Climate	Negligible	Negligible	Negligible	Negligible
Systems using EMF	None	Negligible	Negligible	Negligible
Phytobenthos	None	Negligible	Negligible	Negligible
Macrozoobenthos	Low	Moderate	Moderate	Moderate
Ichthyofauna	Negligible	Negligible	Negligible	Negligible
Marine mammals	Moderate	Moderate	Moderate	Moderate
Migratory birds	Negligible	Negligible	Negligible	Negligible
Seabirds	Important	Important	Important	Important
Bats	Negligible	Low	Negligible	Negligible
Wildlife corridors	Negligible	Negligible	Negligible	Negligible
Biodiversity	Low	Important	Important	Low
Cultural values, monuments and archaeological sites and objects	None	None	None	None
Use and management of the water area and tangible property	Low	Low	Low	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 BC-Wind OWF, the following is expected:

- during the construction phase:
 - 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;
 - 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 [261, 364, 250];

- 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 (to reduce noise), regardless whether the two sources are located within the BC-Wind OWF Area or one of them is in the area of another, neighbouring OWF;
- 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 operation phase:
 - painting the blade tips bright colours, which should increase the likelihood of the operating wind turbine 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 turbine 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.

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 as e.g., the type of foundation or the size of wind turbines. 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 western side of the BC-Wind OWF in order to enable free movement of birds between the Baltic Power OWF and the BC-Wind OWF.

In particular, this Report shows that there are no significant impacts related to the exact location of wind turbines inside the OWF Development Area with respect to all environment components in all phases of the project. Since at the preparation stage of the EIA Report, the final number and size of the rotor of individual wind turbines was not known, and the collection of core samples was planned at a later date, it seems that if a reassessment of the environmental impact is required as part of the planning permission procedure, the collision risk for migratory birds, underwater noise during piling, the impact on the resources of aggregate raw materials and the possibility of occurrence of traces of settlements, may be re-examined.

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 turbines 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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- 2 BCW_REP_ROOS_EN_A_APP_02: Results of model calculations. Suspended solids dispersion in the BC-Wind OWF Area
- 3 BCW_REP_ROOS_EN_A_APP_03: Results of model calculations of underwater noise propagation during piling
- 4 BCW_REP_ROOS_EN_A_APP_04: Assessment of the BC-Wind OWF impact on migratory birds with reference to the barrier effect and the risk of collision on the basis of model calculations
- 5 BCW_REP_ROOS_EN_A_APP_05: Visualisation of the view on the BC-Wind OWF

22 Non-specialist abstract

22.1 Introduction

22.1.1 Preface

This document constitutes the Environmental Impact Assessment Report for the B-Wind and C-Wind Offshore Wind Farms (hereinafter referred to as: BC-Wind OWF).

The investor applying for the determination of the conditions for the implementation of the project in question is C-Wind Polska Sp. z o.o. with its registered seat in Warsaw, at Al. Jerozolimskie 98, 00-807 Warsaw, entered under KRS number: 0000396848 into the Register of Entrepreneurs, Statistical Identification Number (REGON): 1531686, Tax Identification Number (NIP): 5862272911. The owner of C-Wind Polska Sp. z o.o. is OW Offshore S.L. (<https://www.oceanwinds.com/>) – a joint-venture between EDP Renewables SA and ENGIE SA. OW Offshore S.L. brings together all projects implemented to date and is the sole entity for the implementation of EDPR and ENGIE's offshore wind energy projects worldwide. At present (as of 1 October 2021), the company has approximately 1.5 GW of projects under construction and a pipeline of projects with a planned capacity of 4.0 GW under development.

The planned project is the BC-Wind OWF with the maximum total capacity of 500 MW located in the maritime areas of the Republic of Poland, covering the area of 86.28 km², at a distance of approx. 22.6 km from the seashore [Fig. 1].

The planned project covers the construction, operation and decommissioning of the BC-Wind OWF. It will consist of up to 41 wind turbines, 188 km cable routes and up to 6 other objects.



Fig. 1. Location of the planned BC-Wind OWF project [Source: internal materials]

On 9 May 2012, C-Wind Polska sp. z o.o. obtained permit no. MFW/7/12 from the Minister of Transport, Construction and the Maritime Economy 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 200 MW oraz infrastruktura techniczna, pomiarowo-badawcza i serwisowa związana z etapem przygotowawczym, realizacyjnym i eksploatacyjnym” [literally: “Complex of offshore wind farms with the maximum total power of 200 MW together with technical, measurement and research and service infrastructure associated with the pre-investment, implementation and operation stages”] (ref. no.: GT7ak/62/1165094/decyzja/2012), while on 6 February 2013 B-Wind Polska sp. z o.o. obtained permit no. MFW/4/13 from the Minister of Transport, Construction and the Maritime Economy 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 200 MW oraz infrastruktura techniczna, pomiarowo-badawcza i serwisowa związana z etapem przygotowawczym, realizacyjnym i eksploatacyjnym” [literally: “Complex of offshore wind farms with the maximum total power of 200 MW together with technical, measurement and research and service infrastructure associated with the pre-investment, implementation and operation stages”] (ref. no.: GT7/62/1172655/decyzja/2013).

On 18 February 2021, C-Wind Sp. z o.o. applied to the Ministry of Infrastructure for the decision on transferring the permit for B-Wind Polska to C-Wind Polska. On 31 March 2021, the Minister of Infrastructure issued the decision on transferring the permit issued for B-Wind Polska Sp. z o.o. to C-Wind Polska Sp. z o.o. by way of letter GM-DGM-7.530.36.2021.

At the same time, the Investor has planned to enlarge the development area by 2.34 km² to obtain a maximum production of electricity for the planned OWF. As a result, the Investor shall submit an application for the permit for the construction and use of artificial islands, structures and devices in Polish Maritime Areas for the additional area. In view of the above, the application for the decision on environmental conditions includes the additional area slightly exceeding the boundaries of the PSZW already issued.

Table 1 summarises the basic parameters of the planned BC-Wind OWF in the Applicant Proposed Variant (APV).

Table 1. Most important parameters of the BC-Wind OWF for the Applicant Proposed Variant [Source: internal materials]

Name of a structure or parameter	Unit	Value
Number of wind turbines (maximum)	pcs.	41
Single wind turbine capacity (minimum)	MW	12
Number of offshore substations and other built features (maximum)	pcs.	6
Length of cable routes of the inner OWF systems (maximum)	km	188

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 BC-Wind OWF, the competent authority is the Regional Director for Environmental Protection in Gdańsk.

The area of the planned project is covered by the Maritime Spatial Plan of Polish Sea Areas, at a scale of 1:200 000, adopted by the Regulation of the Council of Ministers of 14 April 2021 on the adoption of the Maritime Spatial Plan for internal sea waters, territorial sea and the exclusive economic zone, at a scale of 1:200 000 (Journal of Laws of 2021 item 935), hereinafter referred to as the MSPPSA. The BC-Wind OWF Development Area assumed allows for a conclusive statement that it is consistent with the MSPPSA, in particular: it is situated in the sea area 46.E, where the primary function is obtaining energy from renewable sources; it lies 2 NM away from sea areas with the primary function of Transport; and it is situated 4 km away from the Baltic Power OWF, leaving the area free of development available for the movements of migratory birds.

The “Environmental Impact Assessment Report for the BC-Wind Offshore Wind Farm” was prepared by MEWO S.A. in collaboration with subcontractors: Maritime Institute of the Gdynia Maritime University (formerly: Maritime Institute in Gdańsk), National Marine Fisheries Research Institute, IFAO, Marea Sp. z o.o., DHI Polska Sp. z o.o.

22.1.2 Project classification

The project covered by the application is an offshore wind farm within the meaning of Art. 3(3) of the Act of 17 December 2020 on promoting electricity generation in offshore wind farms.

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) plants using wind energy for electricity generation located in maritime areas of the Republic of Poland are qualified as such.

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

The implementation of BC-Wind OWF 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:

- characteristics 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 regulations, 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 operation of the BC-Wind 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 operation as well as decommissioning stages;
- the need to protect people, people's health and living conditions from negative impacts;
- proposals for environmental monitoring conducted in all phases of the project.

The subject of the document is the analysis of the planned BC-Wind OWF impact 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 Report basis

The basis for the preparation of this report was:

- Applicant's documentation:
 - permit from the Minister of Transport, Construction and the Maritime Economy No. MFW/7/12 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 200 MW oraz infrastruktura techniczna, pomiarowo-badawcza i serwisowa związana z etapem przygotowawczym, realizacyjnym i eksploatacyjnym" [literally: "Complex of offshore wind farms with the maximum total power of 200 MW together with technical, measurement and research and service infrastructure associated with the pre-investment, implementation and operation stages"] (ref. no.: GT7ak/62/1165094/decyzja/2012),
 - permit from the Minister of Transport, Construction and the Maritime Economy No. MFW/4/13 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 200 MW oraz infrastruktura techniczna, pomiarowo-badawcza i serwisowa związana z etapem przygotowawczym, realizacyjnym i eksploatacyjnym" [literally: "Complex of offshore wind farms with the maximum total power of 200 MW together with technical, measurement and research and service

infrastructure associated with the pre-investment, implementation and operation stages”] (ref. no.: GT7/62/1172655/decyzja/2013),

- Action Plan for Counteracting Threats and Contamination from Oil Spills,
- Navigational Risk Assessment,
- Expert opinion on the impact on the safety of surveys on identification and operation of mineral resources of the seabed,
- Documentation containing the results of environmental surveys and inventory carried out in the period from August 2019 to January 2021 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 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 consistent with the environmental objectives of the binding strategic and planning documents analysed.

22.1.7 Information on the links between the BC-Wind OWF and other projects

In the BC-Wind OWF Area, the launch of OWFs of other investors is planned. Currently, none of these projects have been implemented. The projects are at various stages of development. Five of them have obtained the decision on environmental conditions of the project (Baltic Power OWF, Bałtyk II OWF, Bałtyk III OWF, Baltica 2 and Baltica 3 – as Baltica OWF), for FEW Baltic II the EIA Report has been submitted at the Regional Directorate for Environmental Protection in Szczecin.

22.1.8 Methodology of assessment of the planned project impacts

When preparing this EIA Report, the results of environmental surveys and inventory surveys carried out in 2019–2021 were used. The study also takes into account the results of the information meeting, which was 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, operation, simultaneous construction and operation, 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 was 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, environmental surveys and environmental inventories available, 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 resistance of the receptor 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, 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 BC-Wind OWF with a total installed capacity not exceeding 500 MW, together with the technical, measurement and survey as well as service infrastructure related to the preparatory, implementation and operation phases, located in the Polish EEZ.

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

- wind turbines 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 turbine 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 BC-Wind 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 BC-Wind 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 Project location and the sea area occupied by the project

The BC-Wind OWF Development Area is located in the Polish EEZ, north of Choczewo and Krokowa municipalities, 22.6 km from the shoreline [Fig. 2]. The BC-Wind Development Area is described by the geographical coordinates indicated in Table 2 and presented in figure [Fig. 3]. The BC-Wind OWF project will be executed as a single operation or in stages within the area indicated in the PSzW no. MFW/7/12 and PSzW no. MFW/4/13 as well as the north-eastern part of sea area 46.E, insofar as:

1. it is not limited by the planning requirement to leave 2 nautical miles of free space from sea areas with the primary function of transport (54.T);
2. the distance to the Baltic Power OWF DA is not less than 4 km.

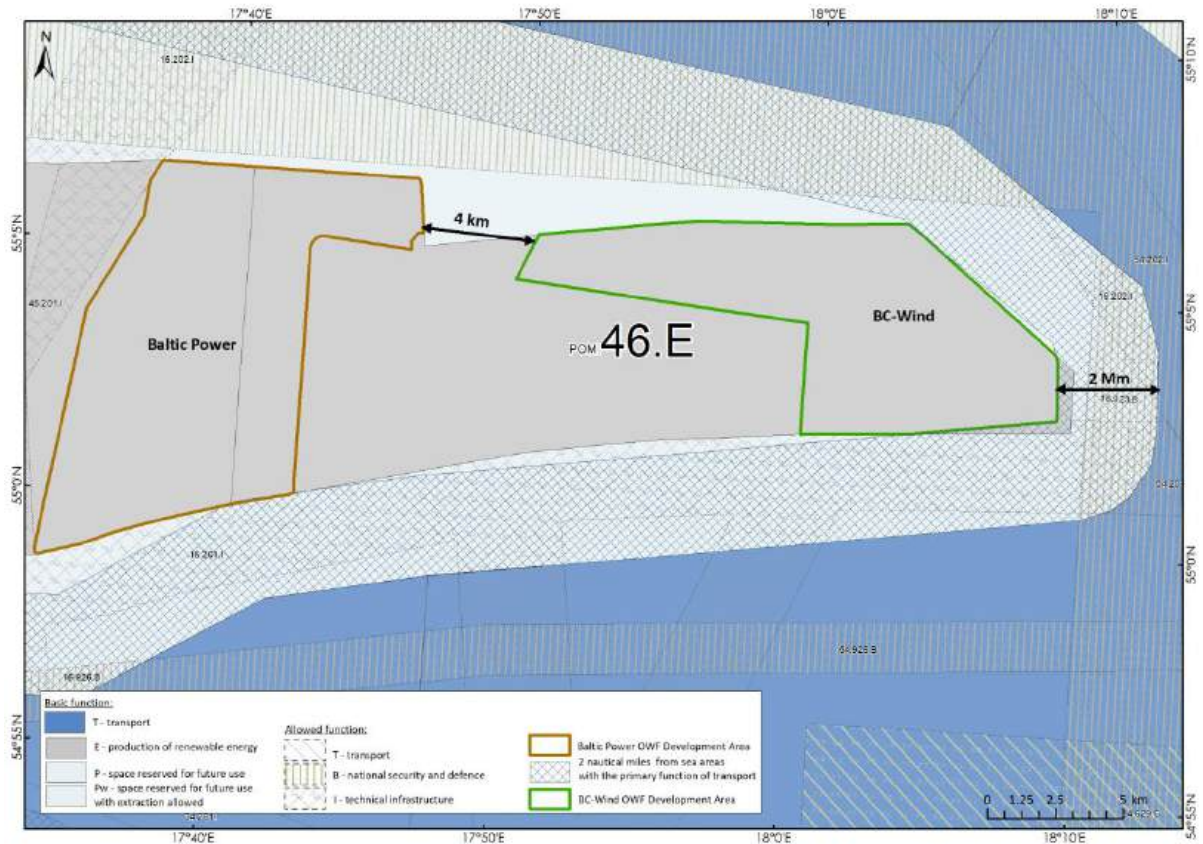


Fig. 2. Location of the project against the background of the Maritime Spatial Plan for internal sea waters, territorial sea and the exclusive economic zone, 1:200 000 scale [Source: internal materials]

The surface of the BC-Wind OWF Area is 90.94 km², while the surface of the BC-Wind OWF DA is 86.28 km².

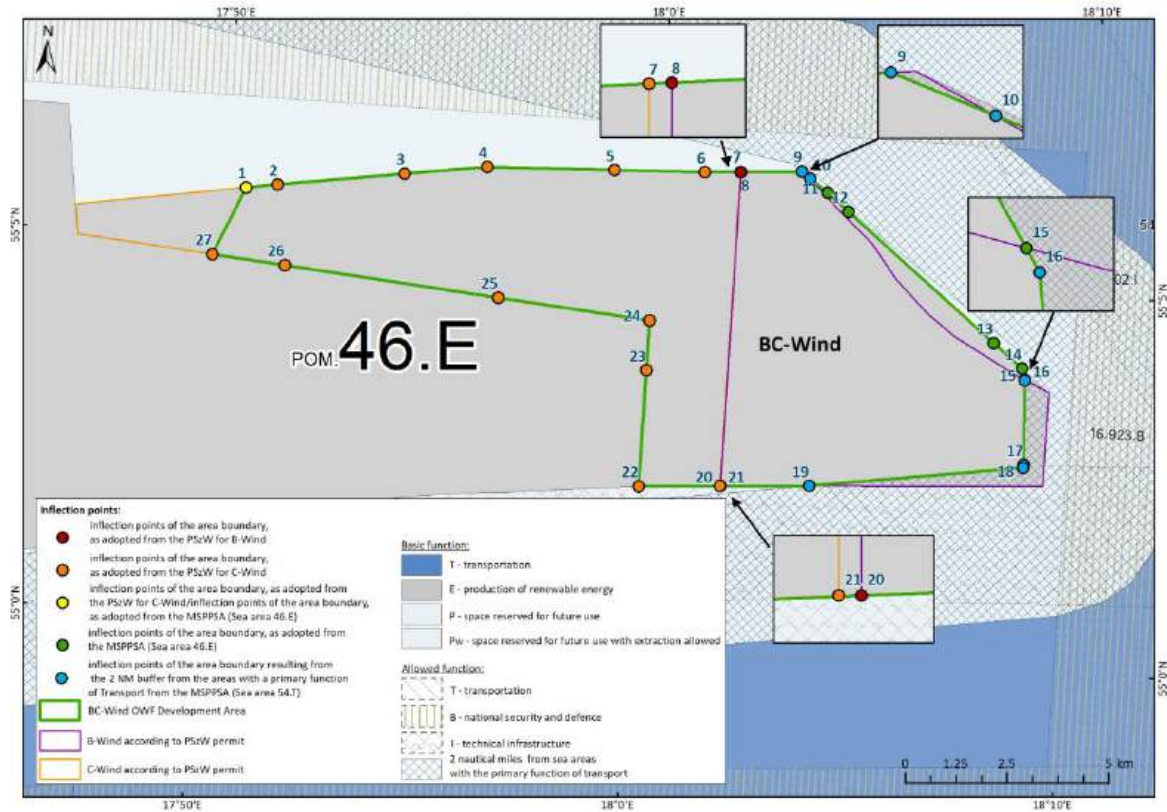


Fig. 3. Location of the project with reference to the decisions issued: PSzW no. MFW/7/12 and no. MFW/4/2013 [Source: internal materials]

Table 2. Geodetic coordinates of the BC-Wind OWF Development Area [Source: internal materials]

Point no.	GRS80H geodetic coordinate system [DD°MM'SS,SSS"]		Comments
	λ	ϕ	
1	17°50'29,701" E	55°05'41,945" N	C, P
2	17°51'12.921" E	55°05'45,974" N	C
3	17°54'07,585" E	55°06'01,656" N	C
4	17°56'01,352" E	55°06'11,346" N	C
5	17°58'58.043" E	55°06'15,594" N	C
6	18°01'03.574" E	55°06'18,656" N	C
7	18°01'52.922" E	55°06'20,769" N	C
8	18°01'53.282" E	55°06'20,785" N	B
9	18°03'17.508" E	55°06'24,392" N	T
10	18°03'30.060" E	55°06'19,193" N	T
11	18°03'55.078" E	55°06'08,831" N	P
12	18°04'25.851" E	55°05'54,849" N	P
13	18°07'58.862" E	55°04'18.065" N	P
14	18°08'40.068" E	55°03'59.343" N	P
15	18°08'44.911" E	55°03'50.593" N	P
16	18°08'45.125" E	55°03'50.205" N	T

Point no.	GRS80H geodetic coordinate system [DD°MM'SS,SSS"]		Comments
	λ	ϕ	
17	18°08'50.792" E	55°02'43.042" N	T
18	18°08'50.365" E	55°02'40.918" N	T
19	18°03'56.238" E	55°02'15.151" N	T
20	18°01'53.405" E	55°02'10.619" N	B
21	18°01'53.045" E	55°02'10.619" N	C
22	18°04'00.360" E	55°02'06.000" N	C
23	18°04'00.360" E	55°03'38.548" N	C
24	18°04'00.359" E	55°04'18.343" N	C
25	17°56'28.930" E	55°04'28.352" N	C
26	17°51'30.273" E	55°04'42.490" N	C
27	17°44'49.441" E	55°04'47.263" N	C

P – inflection points of the area boundary, as adopted from the MSPPSA (Sea area 46.E)

B – inflection points of the area boundary, as adopted from the PSzW for B-Wind

C – inflection points of the area boundary, as adopted from the PSzW for C-Wind

T – inflection points of the area boundary resulting from the 2 NM buffer from the areas with a primary function of Transport from the MSPPSA (Sea area 54.T)

22.2.1.3 Analysis of compliance with the Maritime Spatial Plan of Polish Sea Areas

On 14 April 2021, the Maritime Spatial Plan for internal sea waters, territorial sea and the exclusive economic zone, 1:200 000 scale, was adopted by the Regulation of the Council of Ministers (Journal of Laws of 2021, item 935).

The areas analysed are located entirely in sea area POM.46.E [Fig. 3], for which the basic function is renewable energy generation. On the basis of the planning analysis conducted, it should be stated that the BC-Wind OWF implemented in the BC-Wind DA complies with the applicable Maritime Spatial Plan of Polish Sea Areas, at all stages of the project life-cycle.

22.2.1.4 Stages of 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 B-Wind Sp. z o.o. and C-Wind Sp. z o.o. in force;
- optimise economically the entire project;
- enable the comprehensive contracting of the necessary services and supplies;
- consider 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 the offshore wind farms. 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 turbines 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 turbines together with the associated infrastructure designed to deliver the electricity produced to an onshore substation or to monitor the OWF capabilities.

Wind turbines 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 turbine, ii) foundations or support structures, iii) connection infrastructure, iv) non-productive infrastructure.

22.2.2.2.1 Wind turbine

Wind turbine is an essential component of a 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 turbine, 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 turbine, 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 turbine. 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 electric 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 turbine depends largely on the size of the rotor.

22.2.2.2.2 Support structures with foundations

The tower of a wind turbine 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 turbine;
- support for wiring systems;
- connection of a wind turbine to the seabed;
- effective installation of a wind turbine.

Selection of the appropriate type of support structure or foundation depends on the size and weight of the wind turbine 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 BC-Wind 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 turbines 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 turbines to land. Among these, the following types can be distinguished:

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

Substations are designed to adjust the voltage of current from wind turbines to the required transmission voltage. **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 BC-Wind OWF implementation, it is possible to build (optionally) up to four platforms not directly related to power generation, which may include measurement and survey platform and accommodation and service platforms.

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 turbines;
- the maximum diameter of the rotor of a wind turbine;
- the minimum clearance between the rotor operation area and the water surface;
- the maximum height of a wind turbine structure including the rotor;
- the maximum length of cable routes of the OWF internal wiring.

22.2.3.2 Variants of the project considered along with the justification for 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 decisions issued), 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 BC-Wind OWF will achieve the maximum total nominal power specified in the PSzW. This variant provides for the possibility of using wind turbines of various capacities, however, the power of an individual turbine cannot be lower than 12 MW. Moreover, different types of foundations or support structures are allowed. The implementation of the BC-Wind OWF project with a total maximum capacity (up to 500 MW) assumes the installation of up to 41 wind turbines.

The Applicant assumes the installation of wind turbines of at least 12 MW under this variant, any other feasible solution (with higher turbine capacity) will result in the following: the decrease in the number of wind turbines, 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 turbine with a capacity of

8 MW. The assumed wind turbine capacity, with a maximum total nominal capacity of the OWF indicated in PSzW, determines the number of wind turbines, which for this variant is 62.

Similarly to the APV, it is assumed, in the RAV, that different types of wind turbines 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 3] presents the most important parameters of the project for both variants analysed in this EIA Report.

Table 3. Compilation of key parameters of the BC-Wind OWF for the Applicant Proposed Variant (APV) and the Rational Alternative Variant (RAV) [Source: internal materials]

Parameter	Unit	APV	RWA
Maximum installed capacity	MW	500	500
Maximum number of wind turbines	-	41	62
Maximum rotor diameter	m	280	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	-	6	6
Maximum length of cable routes in internal wiring	km	188	188

22.2.4 Description of individual 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 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 BC-Wind OWF project, such following ports of installation are considered as: 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 operation phase of the BC-Wind 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, Darłówko 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 BC-Wind 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 3 years – 5 years at maximum. Before the commencement of the OWF construction phase, it will be necessary to set up an onshore area, where the assembly of wind turbine 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 BC-Wind 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 BC-Wind 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 operation phase

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

22.2.4.4 Operation phase

Unlike the construction phase, this phase will be characterised by reduced vessel traffic. Regarding the general vessel traffic, an increased proportion of small and medium-sized vessel traffic related to the OWF operation and maintenance will be recorded for this phase.

The number of specialist offshore operations related to the operation phase of the BC-Wind OWF will be proportional to the number of facilities installed and constructed in the OWF Area, also including 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.

The OWF operation will be a long-term project. Offshore wind turbines 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 2°C.

Generation of waste related to a normal operation of the OWF is expected. The main factors causing the generation of waste and wastewater during the BC-Wind OWF operation stage will be the operation of ships and performance 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 BC-Wind OWF will be proportional to the number of facilities installed and constructed in the OWF Area, also including 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 BC-Wind OWF Area will take place to the level of the seabed. In the case of the decommissioning of the BC-Wind OWF, the generation of waste is mainly related to the physical removal of the worn-out components of the BC-Wind 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 BC-Wind 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 turbines and other OWF facilities.

The number of offshore operations related to the construction, operation and decommissioning phase of the BC-Wind OWF will be proportional to the number of facilities installed and constructed in the

OWF Area, also including the length of the installed electricity grid. 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 accidents 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 operation 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.

22.2.5.2 Accident description with an assessment of potential impacts

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 operation or decommissioning.

During the construction, operation and decommissioning phase of the BC-Wind 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 turbines, 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.

22.2.5.3 Other types of releases

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.

22.2.5.4 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 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. It can be assumed that this factor will not affect the protected areas significantly.

During the OWF **operation 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 operation.

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

The collision of ships 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 low. 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 operation phase is the release of hazardous substances into the environment as a result of collisions of ships. 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 operation phase** the collision of ships, 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 operation 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 above-described impacts occurring in the OWF construction phase.

22.2.5.5 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, operation and decommissioning of the OWF. These activities include, among others:

- developing plans for safe construction, operation 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;
- developing plans of safe navigation;
- providing appropriate navigational support;
- 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.

22.2.5.6 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, rescue plans;
- fire hazards;
- threats of environmental pollution – a plan to counteract the threats and contamination by oil;
- threats of construction disasters.

22.2.5.7 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 operation. All devices are subject to continuous monitoring. The rotor is stopped automatically if the wind speed exceeds the limit value for safe wind turbine operation. The service plan is intended to ensure flawless operation.

The greatest potential risks occur during the construction phase; however, the risk of a 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.

22.2.5.8 Risk of major accidents and natural or constructional 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 m³ of diesel oil emission, the risk level is within an acceptable range. The emission of 200 m³ of diesel oil will cause insignificant damage to the environment.

22.2.6 List of measures for preventing unplanned events and reducing their effects

The assumptions of measures for preventing unplanned events resulting from the implementation of the BC-Wind OWF and reducing their effects on the safety of the natural environment and humans are indicated in Table 4.

Table 4. Measures for preventing unplanned events resulting from the implementation of the BC-Wind OWF and reducing their effects on the safety of the natural environment and humans [Source: internal materials]

Event	Preventive measures
Potential collisions with the vessels travelling along the shipping routes within the area as well as vessels taking part in the construction of the neighbouring wind farms	During the construction and operation of the BC-Wind OWF, all possible countermeasures will be applied with the aim to minimise the risk of collision with vessels, in accordance with applicable regulations and best practices used for this type of offshore projects. Such measures include coordination of vessels operating in vicinity and within the area of an offshore wind farm by implementing a MCP (Marine Coordination Plan), their remote monitoring, marking of the offshore wind farm area at every step of its implementation using navigation buoys, use of surveillance vessel (guard vessels) capable of intercepting other ships. Moreover, the Applicant will be in constant contact with competent people responsible for the safety of navigation within the areas of other offshore wind farm projects to ensure coordination and harmonisation of operations resulting from shipping activity
Oil spills	In case of emergency, the result of which are oil spills, appropriate measures will be taken to prevent the spread of such substances and they will be removed from the environment. The impact assessment of this kind of events was described in the EIA Report in subsections 2.5.1 and 6.1.2.3. Moreover, it should be indicated that all vessels taking part in the operations connected to the BC-Wind OWF) are subject to all provisions of the International Convention for the Prevention of Pollution from Ships (MARPOL)
Collisions with the linear infrastructure on the seabed (pipelines, cables)	There are no pipelines nor subsea cables within the area of the planned project and in its immediate vicinity, therefore, there is no danger of collision with this type of infrastructure

Event	Preventive measures
Encountering UXOs or CWAs due to interference with the seabed	In case UXOs or CWAs are encountered, measures will be undertaken adequate to the situation, including notification of appropriate authorities and services, and in agreement with them, the Applicant will undertake further actions to eliminate the risk
Potential explosions generated by adjacent industrial and military facilities	No industrial and military facilities are present in the vicinity of the BC-Wind OWF area
Events connected to climate changes and extreme weather phenomena	The scale and nature of the climate changes as well as extreme weather phenomena that may occur in the region of the planned project is difficult, if not impossible to foresee. However, due to the nature of the planned project, this hazard is most probably minor. Moreover, at the designing stage of the BC-Wind OEF construction elements, aspects connected to the potential increase of the sea level, ice phenomena and extreme winds, will be taken into consideration

22.2.7 Relations between the parameters of the project and its impacts

The matrix of connections between the project parameters and impacts is presented in Table 5.

Table 5. 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 pollutions
Number of wind turbines	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		
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 cables' laying/burying			X	X		X					X				
Number and size of power substations	X	X		X	X			X							

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 pollutions	Increased traffic and collision risk
Organisation of technological processes (number of vessels, time)					X	X	X	X						X	X	X

22.3 Environmental conditions

22.3.1 Location, seabed topography

The BC-Wind Area is situated east of the Słupsk Bank and approx. 22.6 km north of the Choczewo and Krokowa communes. The BC-Wind OWF Area (1 NM) covers a seabed section with a depth from 27.7 m to 65.3 m. The depth increases in the north-eastern direction.

On the basis of the bathymetric and sonar data analysis, a full identification of the seabed surface relief and characteristics was carried out. On this basis, using the interpretation of the seismic and seismo-acoustic data, and also considering the general knowledge on the BC-Wind Area (1 NM), a map of the seabed types was prepared.

Within the BC-Wind Area analysed (1 NM), three seabed types, different in terms of structure and relief character, were distinguished: kame terraces, erosive-accumulative plain, and the accumulation plain.

22.3.2 Geological structure, seabed sediments, raw materials and deposits

22.3.2.1 Geological structure

According to the data from literature, Quaternary sediments deposited on the Paleogene and Neogene sediments were identified in the seabed structure of the BC-Wind OWF Area (1 NM). Below the Paleogene and Neogene layer, the Permian and Triassic sediments were identified. They occur only in the southern and south-eastern part of the survey area. Below the Permian and Triassic sediments, and in the northern and western part of the BC-Wind OWF Area (1 NM), directly below the Paleogene and the Neogene sediments, the Silurian sediments 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.

In the BC-Wind Area two types of sediments forming the seabed surface were distinguished; the fine- to medium-grained sands, and tills with a stony-gravel abrasive pavement and a sand 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 POPs and harmful substances such as organotin compounds, PAH, PCB, 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 order to identify potential areas of the presence of raw materials useful for the future operation of the BC-Wind Area, the seismo-acoustic and bathymetric data were analysed.

On the basis of the data obtained as part of the environmental surveys conducted, the presence of mineable clastic deposits cannot be excluded. Such an identification requires conducting core sampling to specify the geotechnical parameters of the sediments forming the seabed in the area analysed.

The detailed data on the potential areas of raw material occurrence will be collected as part of further works intended to obtain the building permit. On the basis of these results, the results of the analyses of the nature of the seabed-forming sediments will be presented. The Applicant, when re-assessing the environmental impact, will describe in detail the issue of raw materials including the information on the geotechnical parameters.

22.3.3 Seawater quality

The concentrations of the chemical parameters of water surveyed in the BC-Wind 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 BC-Wind OWF Area (1 NM), on the basis of the oxygen content in the near-seabed layer in summer, indicates a good water status (Class 2). 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. Low concentrations of PAHs, yet slightly higher than the ones cited in literature, were recorded in the BC-Wind OWF Area (1 NM).

Taking into consideration the distance of the BC-Wind OWF Development Area to the nearest surface water body, i.e. Jastrzębia Góra – Rowy CWIIIWB5, and the impact range of the project, it should be assumed that the implementation of the BC-Wind OWF will have no impact on the achievement of the environmental objectives for this surface water body.

22.3.4 Climatic conditions and air quality

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 values of meteorological parameters are consistent with those that could be expected, taking into account the climate characteristics of the Southern Baltic. The meteorological conditions of the sea areas encompassing the BC-Wind 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. $7.4 \text{ m}\cdot\text{s}^{-1}$ and reached $20.2 \text{ m}\cdot\text{s}^{-1}$ at maximum. Winds from the western and south-western sectors prevailed. Air temperature ranged from approx. -1.6°C to approx. 23.1°C . Atmospheric pressure varied from 976.3 hPa to 1043.1 hPa. Relative humidity was characterised by high variability, adopting the values from approx. 36.4% to almost 100%.

22.3.4.3 Air quality

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.

22.3.5 Ambient noise

The results of ambient noise monitoring conducted in the BC-Wind OWF Area, show that the levels of underwater noise (and their variability ranges) indicate values characteristic for the Southern Baltic area.

22.3.6 Electromagnetic field (EMF)

In the marine environment, the values of the electric field and the geomagnetic field are similar. In the BC-Wind OWF Area, there are no artificial sources of electromagnetic field (EMF). 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.

22.3.7 Description of the natural environment components and protected areas

The surveys conducted in the BC-Wind 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. 21 taxa representing two phyla and 6 divisions were found in the macrozoobenthos samples collected from the soft bottom in the BC-Wind OWF Area (1 NM). The most common taxa were the three species of polychaetes: *Pygospio elegans*, *Marenzelleria* sp. and *Bylgides sarsi*, one species of bivalves – *Limecola balthica* and a representative of the malacostracans – *Diastylis rathkei*. On the hard bottom, 17 taxa belonging to 7 divisions were found among periphytic and phytophilic fauna. The most common taxa were: the polychaete *Bylgides sarsi*, the bivalves *Mytilus trossulus*, *Einhornia crustulenta* (bryozoans), *Gonothyraea loveni* (hydrozoan) and the crustacean *Jaera* (*Jaera*) *albifrons*.

In the BC-Wind OWF Area (1 NM), **fish** belonging to 21 taxa were caught. Permanent fish communities included cod, flatfish, 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 adult individuals. The BC-Wind OWF Area is characterised by an ichthyofauna composition typical of the Southern Baltic waters, with a clear predominance of cod and flounder in demersal catches, and herring and sprat in pelagic catches. The BC-Wind OWF Area (1 NM) does not constitute a significant breeding area, however, it can be assumed that in this area the spawning of sprat may take place, the intensity of which – compared to other shallow-water areas – is relatively low.

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 BC-Wind OWF Area (2 NM) surveyed.

During the **migratory bird** surveys, a total of 75 species were observed over the OWF Area (2 NM), for 51 species flight paths were created and 27 species were identified on the basis of acoustic recordings. Within the entire survey period, sea ducks (common scoter, velvet scoter, long-tailed duck), geese

(identified to the family level) as well as passerine birds (identified to the order level), were observed in the highest numbers.

The most abundant migratory fluxes were determined for passerines including pigeons, auks, sea ducks (the long-tailed duck, the common scoter and the velvet scoter), dabbling ducks, and geese. The daytime migration of terrestrial birds was especially intensive in October. The flight altitude analyses conducted in autumn using a vertical radar demonstrate that the intensity of migration at night was higher than during the day, practically throughout the entire period of observations. At the altitudes from 250 MASL, birds were often recorded during daylight hours, especially in October and November. In November, a moderately intense yet noticeable migration was recorded at altitudes above 1200 MASL. In spring, the vertical distribution of bird flight altitudes obtained from the echoes recorded by the vertical radar reflected intense nocturnal migration, especially in April. The visual observations conducted demonstrate that the vast majority of the bird groups and species analysed flew at altitudes of up to 20 MASL.

Seabird surveys were conducted in the BC-Wind OWF Area (2 NM) and in three additional areas of great significance to birds: the Słupsk Bank, a fragment of the Przybrzeżne Wody Bałtyku Area and the Polish part of the Southern Middle Bank area.

In the BC-Wind OWF Area (2 NM), a total of 16 bird species staying in the sea area were recorded, including 12 species connected to the marine environment and 4 species of water birds rarely encountered at sea away from the coast. The European herring gull was definitely the most often recorded species. The razorbill, common guillemot and long-tailed duck were significantly less commonly observed.

In the additional areas, a total of 25 bird species staying in the sea area were recorded, including 15 species connected to the marine environment and 9 species of water birds rarely encountered at sea away from the coast. The long-tailed duck was by far the most dominant in these areas, the velvet scoter was three times less frequent. The results of seabird observations indicated that the BC-Wind 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 BC-Wind OWF Area (2 NM) was confirmed. The calls recorded were assigned to three species of bats: the common noctule, the Nathusius' pipistrelle and the soprano pipistrelle. Additionally, since some signals were impossible to assign to a particular species, they were classified as belonging to the Nyctaloid group. The common noctule was the most numerous of the bat species. The total number of recordings indicates a low activity of bats over the BC-Wind OWF Area (2 NM) during the migration period.

The BC-Wind 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. 12 km – Przybrzeżne wody Bałtyku (PLB990002) and at a distance of approx. 43 km – the Słupsk Bank (PLC990001). At a distance of 37 km away from the BC-Wind 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. Additionally, at a distance of more than 63 km away from the BC-Wind OWF Area, a Swedish Natura 2000 site Hoburgs bank och Midsjöbankarna (SE0330308) is situated.

No **wildlife corridors** run across the BC-Wind OWF Area. They are not identified within the entire Baltic Sea.

Biodiversity of the BC-Wind OWF Area does not differ from the typical biodiversity of the Southern Baltic. There are no species present in the BC-Wind 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 BC-Wind 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 shallower section of the sea area is characterised by greater concentrations of seabirds (the long-tailed duck and the velvet scoter).

There are no elements of the underwater **cultural heritage** in the BC-Wind OWF Area. During surveys conducted in the BC-Wind OWF Area, the presence of 6 shipwrecks, including 4 so far unidentified, was confirmed.

The BC-Wind OWF Area is characterised by a moderate degree of use for the purposes of **navigation** and is used to a small extent by recreational vessels.

Currently, a regular shipping route runs across the BC-Wind OWF Area, which connects the ports of the Bay of Gdańsk with the Bornholm Strait, used primarily by tankers and merchant vessels (bulk carriers).

Activity related to the **fishing industry** is carried out in the BC-Wind OWF Area, conducted mainly by fishing vessels from the port in Władysławowo. The area of the planned project is characterised by a low fishing productivity. The main fish species caught in this area were the herring and sprat.

In the BC-Wind 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 area of the BC-Wind OWF potential impact on the landscape there is a land area in the section from Łeba in the west to Jastrzębia Góra in the east. Due to the shape of the coastal zone, the BC-Wind OWF structural elements can be seen from the beaches along this section. In the context of the binding Maritime Spatial Plan of Polish Sea Areas and no planned restrictions on fishery, the construction of the BC-Wind OWF is of low significance to the commercial and recreational navigation, as well as fishery with reference to **the people and their living conditions**.

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 turbines.

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 and interpreting the results 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 OWF, which interfere in the marine environment the most. The results of the simulations performed lead to the following conclusions: i) higher suspended solids concentrations have a local range in relation to the place of the dredging work performance and do not exceed a distance of 1000 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 4 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 0.8 mm in both variants APV and RAV within the entire BC-Wind OWF Area.

Underwater noise will be emitted to the environment at each stage of the BC-Wind 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 and/or supporting structure with a diameter of 12 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.

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 the 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 mitigation measures in the form of an NRS, the impact zones for a single strike are subject to significant decrease. The impact ranges for repeated pile driver strikes during piling are much greater than those obtained for a single strike. The use of the mitigation measures in the form of a SRH significantly reduces the impact range for repeated strikes.

The presence of wind turbines may lead to **collisions** with passing birds. Among all the species considered in the modelling, the significance of the impact resulting from collisions was assessed as at most of low importance for the long-tailed duck, velvet scoter. In the case of other species, the significance of the collision impact was evaluated as negligible.

22.5 Description of the environmental impacts predicted in the case 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 operation of the BC-Wind OWF may require a compensation of the assumed quantity of energy obtained through operation 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, no investments in the offshore wind power

generation will result in the absence of impacts associated with the construction, operation 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 Project impacts identification and assessment

This impact analysis was carried out separately for the construction phase, the overlapping construction and operation phases in the period from 2 to 3 years – 5 years at maximum, as well as the operation 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 the 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 BC-Wind 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 turbine 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 the seawater and seabed sediment quality

During the construction phase, the BC-Wind 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 anti-fouling 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.

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

The contamination of seawaters or 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, and 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.

The 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 water and/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.

The contamination of seawater and/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 to be negligible for sea waters and seabed sediments.

The contamination of seawater and/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 for adaptation to climate change, impact on atmospheric air (air quality)

During the construction phase of the BC-Wind 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, potential pollutants will disperse 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 offshore area

No impacts will occur due to the absence of **phytobenthos** in the OWF Area before the beginning of the project implementation.

During the construction phase of the BC-Wind 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 four main factors of pressure on the soft and hard bottom macrozoobenthos during the construction phase of the BC-Wind OWF revealed that these impacts were assessed to be of low significance in the event of disturbance of seabed sediments and negligible for all the remaining impacts during this phase of the project.

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 BC-Wind OWF Area. The significance of the impact was assessed to be 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 BC-Wind 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 all fish species. The significance of the impact is assessed to be negligible for all the fish species analysed.

In the construction phase of the BC-Wind OWF, **marine mammals** may be subject to impacts resulting from: i) underwater noise from piling works, ii) noise generated by vessel traffic, iii) increased concentration 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 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 BC-Wind OWF structures were assessed for the operation phase, when their effects are the greatest. The significance of the impact of the BC-Wind 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 of the project site, 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 six most

abundant bird species: the European herring gull, razorbill, common guillemot, velvet scoter, long-tailed duck and common scoter.

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, and for the sea ducks (velvet scoter, long-tailed duck and common scoter) as high.

During the BC-Wind 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 BC-Wind 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 has been established, such as biodiversity, resources, objects and elements of inanimate nature and the landscape of the park.

The BC-Wind OWF will not cause any significant impacts on the Natura 2000 sites: Słupsk Bank (PLC990001) and Przybrzeżne wody Bałtyku (PLB990002).

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 BC-Wind 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 BC-Wind 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 BC-Wind 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 values, monuments and archaeological sites and objects

During the construction phase, the BC-Wind 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 use and development of the sea area and tangible property

Limitations resulting from the gradual exclusion from the previous use of the BC-Wind 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 other fisheries. 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 BC-Wind 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 BC-Wind 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 BC-Wind 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 to be 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 with the distance from the OWF, the vessel traffic will increase periodically, and at ports the impact will be local.

22.6.1.1.8 Impact on population, health and living conditions of people

During the BC-Wind 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 Operation 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 operation phase. The overall impact of the project during the operation phase can be assessed to be negligible.

22.6.1.2.2 Impact on the sea waters dynamics

As a result of the presence of the BC-Wind 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 turbines. However, these are of local nature and should not occur outside the BC-Wind OWF Area. The impact of wind turbines on the wave field and sea current field will be local and will not be of primary significance for these elements.

Significance of the BC-Wind OWF impact on the sea waters dynamics in the APV during the operation phase was assessed to be negligible.

22.6.1.2.3 Impact on the seawater and seabed sediment quality

During the BC-Wind OWF operation, 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 volume 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.

The contamination of the environment with aluminium or zinc released during operation 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 operation phase in the APV was assessed to be negligible for sea waters and seabed sediments.

The increase in the temperature of sediments, in which the cable is buried, and of the 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 the 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 BC-Wind 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 maximum depth of 3 m.

Heat emission by the cables is a direct negative impact of local range, which is long-term, irreversible, permanent over the operation period, and of unspecified intensity. The significance of this impact during the operation phase in the APV was assessed to be negligible for sea waters and seabed sediments.

22.6.1.2.4 Impact on the climate, including greenhouse gas emissions and impacts relevant for adaptation to climate change, impact on atmospheric air (air quality)

Wind turbines will locally reduce wind energy and disturb atmospheric pressure directly in the area of the rotor operation. The wind turbine 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 BC-Wind OWF operation 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 operation 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 BC-Wind OWF impact in the APV during the operation 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 operation of offshore wind farms so far that the operation of wind turbines 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 make arrangements with the relevant users of EMF systems to implement countermeasures required for accepting the impact of the BC-Wind OWF on communication and radio location systems by them. Therefore, it should be assumed that the significance of the impact of the BC-Wind 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 offshore area

During the operation phase, support structures of wind turbines 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 operation of the BC-Wind 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 operation 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 so-called 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 BC-Wind OWF operation 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 BC-Wind OWF operation 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 turbine and wind speed.

Emission of noise and vibrations generated during the OWF operation 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 turbines 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 BC-Wind 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 BC-Wind OWF operation phase, the impacts on **marine mammals** will result from: i) emission of noise generated by wind turbines, ii) emission of noise generated by vessels, iii) changes in habitat, iv) spill of petroleum products to the environment as a result of vessel failures, and v) collisions with vessels.

The most significant impact on marine mammals during the BC-Wind OWF operation phase will be due to the potential vessel collisions and in consequence due to the risk of 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 BC-Wind OWF operation 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 BC-Wind 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. On the other hand, the significance of the impact in the form of collision risk was assessed as low in the case of the long-tailed duck, common scoter and velvet scoter, and insignificant in the case of geese (unidentified as to the species) as well as negligible for other species.

The following were classified as the most significant impacts on **seabirds** in the operation 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 six most abundant bird species: the long-tailed duck, velvet scoter, razorbill, common scoter, 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 (long-tailed duck, velvet scoter and common scoter) as high at most.

The potential impact of the BC-Wind OWF on **bats** during the operation phase will be caused by: i) collisions with wind turbines, ii) emission of noise and light, iii) barrier effect, and iv) habitat change. The significance of the BC-Wind OWF impact during the operation phase was assessed as low.

22.6.1.2.6.2 Impact on protected areas

22.6.1.2.6.2.1 Impact on protected areas other than Natura 2000 sites

Due to the location of the BC-Wind OWF at a significant distance from the Słowiński National Park, during the operation 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.

22.6.1.2.6.2.2 Impact on the Natura 2000 protected areas

As a result of the actual impact assessment of the BC-Wind 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 BC-Wind in relation to the size of the Baltic Sea, including the constant impact of space development, it was assessed that the impact of the BC-Wind OWF on migration routes of migratory species during the operation phase, similarly as during the construction phase, will be negligible.

22.6.1.2.6.4 Impact on biodiversity

During the operation phase of the BC-Wind OWF, 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 can also be positively affected by the long-term restriction or suspension of fishing in the BC-Wind OWF Area. The impact of the “artificial reef” effect will probably be only local and will not increase biodiversity in a larger area.

The BC-Wind OWF operation phase will have no negative impact on the marine mammal biodiversity in the survey area.

In the case of seabirds, as a result of disturbance and displacement from habitats, changes in the distribution of birds in the BC-Wind OWF Area may occur. After a period of disturbance, birds will gradually adapt to the new situation. In the case of species sensitive to the presence of wind turbine 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 objects and sites

In the BC-Wind 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 use and development of the sea area and tangible property

During its operation, the BC-Wind OWF Area will be excluded from navigation due to safety reasons. Decisions on permits for vessels other than the vessels supporting the OWF in the BC-Wind OWF Area will be made by the relevant maritime administration authorities.

As a result of a maritime area being occupied by the BC-Wind OWF, this area may be excluded from the possibility of fishing. The BC-Wind OWF Area is located within two statistical rectangles. 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 operation 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 operation of the BC-Wind OWF will 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.

The access to the BC-Wind 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 BC-Wind OWF Area.

In most weather conditions, the BC-Wind 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 turbines.

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 the resource such as population, health and living conditions of people, is of great value, due to the fact that the distance of the BC-Wind OWF from permanent places of residence and work of people is large, the impact of the BC-Wind OWF was considered negligible.

22.6.1.3 Overlapping of construction and operation phases

When assessing the impact of operations for the overlapping construction and operation phases, the highest significance of impacts from among the ones adopted in the assessments for the construction and operation phases was assumed. In every case assessed, the significance of impacts for the overlapping construction and operation 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 BC-Wind 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 BC-Wind OWF decommissioning phase, no higher significances of those impacts on particular environmental elements assessed were found than the ones established for the construction or operation phases.

As a result of the BC-Wind OWF decommissioning process, the state of biocenotic balance established during the several decades of the operation 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 BC-Wind 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 BC-Wind 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 turbines and the maximum rotor diameter. These two essential parameters of the BC-Wind OWF can generate various impacts on the environment.

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.

22.6.3 Impact assessment for 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 BC-Wind 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 BC-Wind OWF impact on the Natura 2000 sites is to determine whether a given Natura 2000 site is within the range of the potential impacts of the BC-Wind OWF.

The main premises for concluding whether or not the planned project may impact a Natura 2000 protected site are the distance between this site 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 BC-Wind OWF Area is located outside the areas of the European Natura 2000 network. Therefore, when determining the impacts of the planned project on the Natura 2000 sites, the impacts extending beyond the BC-Wind 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 BC-Wind 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 their structure or function.

The Noise Reduction System, which is an integral part of the BC-Wind OWF during the construction phase, is indented to reduce the underwater noise generated during pile driving, so that it does not exceed the TTS (temporary threshold shift) values within the Natura 2000 site boundaries, in which marine mammals and fish 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 BC-Wind 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 the areas for the protection of which they have been established.

The main impact assessment of the BC-Wind OWF on Natura 2000 sites covered the aspect related to the probable impact caused by the disturbance of the airspace over the BC-Wind 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 operation phase of the BC-Wind OWF. In this phase, the airspace above the maritime area will be maximally occupied by the structures both of wind turbines 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 BC-Wind 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 to be negligible for the long-tailed duck and the European herring gull, while for the black guillemot and the common scoter the impact will be absent. Moreover, the existence of corridors (areas with no developments) west of the BC-Wind Development Area (between the Baltic Power OWF and the BC-Wind OWF) 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 BC-Wind OWF, the issue of the impact of the planned project on the integrity of 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 BC-Wind 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 BC-Wind OWF impact on the bird species subject to 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 (including existing, currently implemented and planned projects and activities)

The assessment of the cumulative impact of the BC-Wind OWF implementation in connection with other projects took into account the existing, implemented and planned projects. In the case of the planned projects, only those for which decisions on environmental conditions had been issued were taken into account.

No other projects that may cause cumulative impacts are being implemented nor will be implemented in the BC-Wind 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 accumulate with the impacts of the BC-Wind OWF will have their sources outside its area.

22.7.1 Existing, implemented and planned projects with the decision on environmental conditions

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 BC-Wind 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 five 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 work 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 operation phases of individual OWFs will begin. Finally, the beginning of the operation 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 operation 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 that may cause cumulative impact

The cumulation of impacts of the BC-Wind 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 BC-Wind OWF Area.

The impacts of the BC-Wind OWF that may cause cumulative impacts with other projects (other OWFs: Bałtyk III, Bałtyk II, Baltica 2 and Baltica 3, Baltic Power) 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 operation phase.

22.7.3 Identification of projects which may cause cumulative impacts

The projects indicated above, which have been issued with a decision on environmental conditions can be divided into two groups, i.e. the project related to the extraction of hydrocarbons and gas and the ones related to the acquisition of energy from wind energy in offshore areas. Each of these groups of projects has specific characteristics, with different environmental impacts including their type, scope, time range and scale.

Decisions on environmental conditions for the projects related to the extraction of hydrocarbon and gas indicate the impacts and their significance. In the context of the impact that characterises the BC-

Wind OWF, and which may generate a cumulative impact, the impacts of hydrocarbon and gas extraction are irrelevant since they will not cause the cumulative impact.

In the case of the implementation of six OWFs, i.e. the Bałtyk III, Bałtyk II, Baltica 2 with Baltica 3, Baltic Power, Baltic II and BC-Wind, due to the analogous nature of the projects and the resulting practically identical impacts and their relatively close location, cumulative impact may occur. Each of these projects allows for a similar method of the laying of foundations for wind turbines and the development of the space above the water surface with large-size structures. Moreover, regardless of the date of the construction work commencement, the operation phase of each of these investments is planned for a period of several dozen years, which indicates that from a certain time the resulting environmental impacts may occur.

22.7.4 Assessment of cumulative impacts

22.7.4.1 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 two simultaneous piling operations at most are performed in the area of all OWFs.

22.7.4.2 Increase in the content of suspended solids and their sedimentation

The modelling results for the suspended solids impact on the environment indicate that the dredging works conducted simultaneously in two locations on the foundation of support structures, 3 km apart, 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.

22.7.4.3 Spatial disturbances

22.7.4.3.1 Physical barrier creation

Within the BC-Wind 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, those OWFs, the implementation of which is very probable, i.e. the FEW Baltic II, 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 cranes moderate, whereas, in the case of long-tailed ducks, common scoter, velvet scoter – of low importance.

22.7.4.3.2 Landscape disturbances

Landscape disturbances in the case of cumulative impacts related to the simultaneous operation 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.

22.7.4.3.3 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 BC-Wind OWF and other OWFs on these systems should be considered only as hypothetical, which will not actually occur.

22.7.4.3.4 Fishery

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 will constitute a negative impact of the OWFs presence in the neighbouring locations. The location of other offshore wind farms west of the BC-Wind 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 high. In order to limit the negative impact on fisheries in this regard, navigation corridors should be preserved between the OWFs, with the necessary width ensuring the safety of navigation. In such a case, the significance of the project cumulative impact on fishery may be considered low. Another solution could be to allow the transit of fishing vessels through the BC-Wind OWF Area. Each of those solutions remains the responsibility of the director of a relevant Maritime Office.

22.8 Transboundary impact

The BC-Wind 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 64 km from the Swedish EEZ, ii) 90.5 km from the Danish EEZ, iii) over 67 km from the Russian EEZ, and iv) over 208 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 BC-Wind 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 operation 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 BC-Wind 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. In addition, some of the species affected are listed in Annex I of the Birds Directive or included in the Natura 2000 programme of protected sites in neighbouring countries, and therefore, the impacts of the BC-Wind OWF may affect the abundance of birds which are the subject of protection in those 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 shutdowns of individual wind turbines 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 BC-Wind OWF. The application of the system of shutting down the BC-Wind OWF elements will allow for the minimisation of this project impact on crane migrations.

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, and in the summer period also of the common guillemot. 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. Compared to the Baltic populations, the size of the long-tailed duck, velvet scoter and razorbill population in the BC-Wind 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 BC-Wind OWF are expected.

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 moderate. Taking into account the spatial scale of the OWF areas in relation to the size of the Baltic Sea, including the increasing effect of spatial development, it was assessed that the impact of the BC-Wind OWF on the potential migration routes of migratory species will be negligible during the construction phase. It is necessary to apply mitigating measures in the form of leaving an area free from development between the OWF areas. This will allow to maintain the continuity of migration routes between wintering grounds and avoid the transboundary impact on seabirds in the context of cumulative assessment. Additionally, the application of the system of shutting down the BC-Wind OWF elements will additionally allow to minimise the impact of these projects on the passages of birds.

22.9 Analysis and comparison of the variants considered and the most beneficial variant for the environment

Considering the PSzW issued for the BC-Wind OWF and the binding Maritime Spatial Plan of Polish Sea Areas, it would be unreasonable to analyse a different location variant for 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 offshore wind energy. The maximum installed capacity of the BC-Wind OWF, i.e. 500 MW, was adopted as the limit parameter in both variants considered. Therefore, using power stations with higher capacity, it becomes possible to erect a smaller number of wind turbines.

The RAV assumes wind turbines of 8 MW capacity in the analyses. Taking into account the maximum installed capacity of the BC-Wind OWF, in this variant, it would be necessary to construct 62 wind turbines. With the wind turbine capacity of 12 MW assumed in the APV, the maximum installed power will be achieved already after the construction of 41 wind turbines.

Construction and operation of a smaller number of wind turbines 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 operation phase, a smaller number of wind turbines 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 bird collisions with the wind turbine 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 operation phase is assumed), these differences are an important premise 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 technology proposed with the technology compliant with the requirements stated 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 will 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 BC-Wind 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 energy 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 operation, wind turbines 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 turbines. They will not affect marine organisms significantly nor cause noticeable electromagnetic interactions.

Experience regarding the use of wind turbines 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 BC-Wind 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 BC-Wind 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 of whether the two sources are located within the BC-Wind OWF Area or one of them is in the area of a neighbouring OWF;
- 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.

The mitigation measures proposed for the operation phase include:

- painting the blade tips bright colours, which should increase the likelihood of the operating wind turbine 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 turbine towers (not applicable to foundations or supporting structures), due to the greater probability of bird collisions with power stations of such structure (less visible to birds from a greater 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;

22.12 Proposal for the monitoring of the planned project impact and information on the available results of other monitoring, which may be important for establishing responsibilities in this area

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 operation 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 operation and iii) the completion of construction.

During the implementation of the BC-Wind 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 The information on the results available for other monitoring, which may be important for establishing responsibilities in this area

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 Fisheries Monitoring Centre collects data on the volume of fish catches carried out in the Polish Maritime Areas. The analysis of these data will enable the future assessment of the actual impact of the planned project on fishery.

In the long-term perspective of several dozen years, for which the implementation of the BC-Wind 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 BC-Wind 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. This decision 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.

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 BC-Wind 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;
- disturbance in the environment that may result from the planned OWF.

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 this Report preparation, an information meeting with the representatives of fishermen's organizations was held in June 2021. Formal consultations will be carried out during the environmental impact assessment procedure conducted by the Regional Director for Environmental Protection. 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 that may be influenced by a wind farm in the Polish Maritime Areas is not uniform. Some aspects, especially the biotic ones, are better identified, e.g. the occurrence of zoobenthos, and for others 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 operation 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 turbines 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.